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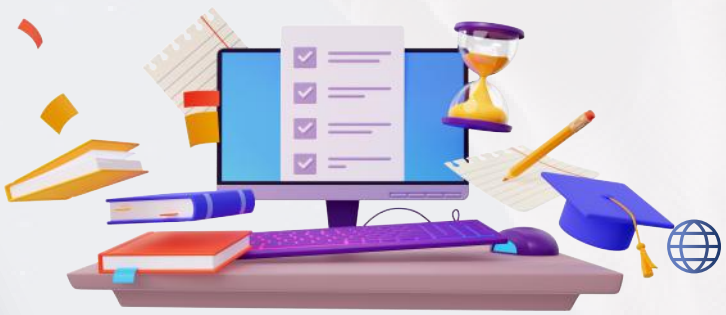
Science & Technology Part 1



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SYLLABUS

SCINEC AND TECHNOLOGY

1. SPACE AND SPACE TECHNOLOGY

- Evolution of universe: Big bang to present
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    - Dark energy
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5. NANO TECHNOLOGY AND ROBOTICS

- Basics of Nano Science and nanotechnology
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- Applications of nano tech in medicine and healthcare, agriculture, robotics, defence, space, energy etc.
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6. COMMUNICATIONS, IT AND COMPUTER SYSTEMS

- Cyber security threats

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- Data protection bill
- Basics of mobile network like GPRS, 3G, 4G, 5G etc
- Mobile technologies eg – Android, mobile applications, Warp Charging
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- Indices like Global Cybersecurity Index (GCI); Broadband Readiness Index for States etc
- Optical fiber Network
- D2H Vs OTT
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- Block chain technology
- Internet of Things
- Artificial Intelligence
- Digital India and other government initiatives
- Digital payment platforms
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- Data mining

Q.1) Consider the following features with respect to CubeSats:

1. Standardized
2. Relatively expensive
3. Large size

How many of the above are features of CubeSats?

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

Q.1) Solution (a)

Explanation:

- CubeSats are a class of nanosatellites that follow a standardized modular design. They are small, lightweight, and cost-effective, making them accessible for academic, commercial, and government space missions.
- CubeSats are built based on standard dimensions and design specifications (e.g., 1U, 2U, 3U configurations), which simplifies their integration with launch vehicles and reduces development time and costs. Typically, they are built in units of 10x10x10 cm (referred to as "1U") and can be combined into larger configurations like 2U, 3U, etc. **(Statement 1 is correct)**
- CubeSats are known for being relatively inexpensive compared to traditional satellites. Their small size and use of off-the-shelf components make them highly cost-effective. **(Statement 2 is incorrect)**
- CubeSats are characterized by their small size, typically starting at 10x10x10 cm (1U). Even larger CubeSats (e.g., 3U or 6U) are much smaller than traditional satellites. **(Statement 3 is incorrect)**

Q.2) With reference to Solar cycle, consider the following statements:

1. It is the cycle that the Sun's magnetic field goes through approximately every 11 years.
2. It affects the sunspots on the surface of the Sun.
3. It leads to switching of places between Sun's north and south poles.

How many of the statements above is/are correct?

a) 1 only
b) 1 and 2 only
c) 2 and 3 only
d) 1, 2 and 3

Q.2) Solution (d)

Explanation:

- The solar cycle refers to the periodic changes in the Sun's magnetic activity, solar radiation, and the number of sunspots over an average duration of 11 years. During the cycle, the Sun alternates between periods of high solar activity (solar maximum) and low activity (solar minimum).
- The solar cycle is primarily driven by the Sun's magnetic field, which undergoes regular fluctuations. Approximately every 11 years, the Sun's magnetic field completes a cycle, transitioning from a solar minimum (fewer sunspots) to a solar maximum (many sunspots) and back. **(Statement 1 is correct)**
- Sunspots are dark regions on the Sun's surface caused by intense magnetic activity. The number of sunspots increases during the solar maximum and decreases during the solar minimum, directly correlating with the solar cycle. This observable phenomenon provides a clear measure of the cycle's progression. **(Statement 2 is correct)**
- During each solar cycle, the Sun's magnetic field reverses polarity, meaning the north and south magnetic poles switch places. This flip occurs during the solar maximum and resets for the next cycle, making it an integral feature of the solar cycle. **(Statement 3 is correct)**
- The solar cycle significantly impacts space weather, including solar flares and coronal mass ejections, which can influence Earth's magnetosphere and satellite operations.

Q.3) Sometimes seen in news, what do you understand by the term 'LignoSat'?

a) A nanosatellite made from bamboo, developed to test renewable materials in space.
b) A SpaceX program to recycle satellite components using biodegradable materials.
c) The world's first wooden satellite designed to minimize space debris.
d) A European Space Agency mission to develop sustainable satellite fuels.

Q.3) Solution (c)

Explanation:

- While bamboo has been explored for its strength and renewability in certain engineering applications, there is no known bamboo-based satellite like LignoSat. Bamboo as a material has been used in other eco-friendly innovations, such as bicycles and construction, but it has not yet reached practical use in space systems.
- SpaceX focuses on reusable launch systems, such as the Falcon 9 and Starship rockets, but does not have a specific program like Lignosat.
- LignoSat, developed by Japanese researchers, is a wooden satellite made from magnolia wood, marking a pioneering step in using renewable and eco-friendly materials in space technology.
- It will test the material's durability in the harsh space environment and aims to address the issue of space debris. When LignoSat re-enters the Earth's atmosphere, it is expected to burn up completely without leaving harmful debris. **(Option (c) is correct)**
- ESA is actively researching green propulsion technologies, such as the use of water-based or hydrogen peroxide-based fuels, but this is unrelated to LignoSat. ESA's green propulsion initiatives are part of its Clean Space program, aiming to reduce the environmental impact of space activities both in orbit and on Earth.

Q.4) Frequently seen in news, the terms 'Callisto', 'Europa' and 'Ganymede' are associated with which of the following?

a) Exoplanets discovered by the James Webb Space Telescope
b) Prominent Moons of Jupiter
c) Asteroid clusters in the Kuiper Belt
d) Important Satellites of Saturn

Q.4) Solution (b)

Explanation:

- While the James Webb Space Telescope is making groundbreaking discoveries of exoplanets and their atmospheres, Callisto, Europa, and Ganymede are not exoplanets but moons within our Solar System.
- Callisto, Europa, and Ganymede are three of the four largest moons of Jupiter, collectively known as the Galilean moons, discovered by Galileo Galilei in 1610. These

moons have been the focus of recent scientific missions due to their potential for supporting life and their unique geological features:

- Europa: Believed to have a subsurface ocean, making it a prime candidate for extraterrestrial life.
- Ganymede: The largest moon in the Solar System, with its own magnetic field.
- Callisto: Known for its heavily cratered surface, suggesting it is geologically inactive. **(Option (b) is correct)**

- The Kuiper Belt is a region beyond Neptune containing icy bodies and dwarf planets like Pluto. Callisto, Europa, and Ganymede are unrelated to the Kuiper Belt, as they are Jovian moons within the Solar System.
- Saturn has many moons, including Titan and Enceladus, which are also of Astrobiological interest.

Q.5) Consider the following statements:

1. Satellite Technology Day (STD) is celebrated annually in India on 19th of April.
2. STD commemorates the birth anniversary of the former ISRO Chairman Dr. Udupi Ramachandra Rao.

Which of the statements given above is/are correct?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Q.5) Solution (a)

Explanation:

- Satellite Technology Day is observed annually on April 19 in India to commemorate the launch of Aryabhata, India's first satellite, which was launched on this day in 1975. **(Statement 1 is correct)**
- While Dr. U.R. Rao is one of the most celebrated figures in India's space history, credited with pioneering the development of satellite technology in India, Satellite Technology Day does not commemorate his birth anniversary. Dr. Rao's contributions are often remembered in the context of satellites like INSAT and GSAT series, but the day itself is tied to Aryabhata's launch. **(Statement 2 is incorrect)**

- Aryabhata was a landmark achievement in India's space history, marking the beginning of India's foray into space technology. The day is significant for recognizing the progress made by ISRO and the role of satellite technology in national development.

Q.6) Consider the following statements:

Statement-I: Planets are shaped into spheres because gravity acts uniformly in all directions.
Statement-II: The rotation of planets causes makes them into an oblate spheroid shape.

Which one of the following is correct in respect of the above statements?

a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I
b) Both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I
c) Statement-I is correct Statement-II is incorrect
d) Statement-I is incorrect but Statement-II is correct

Q.6) Solution (b)

Explanation:

- Gravity is the key force responsible for shaping planets into spheres. It pulls matter toward the center uniformly, resulting in a spherical structure when the celestial body is large enough for gravity to overcome other forces like electromagnetic forces or rigidity of the material. **(Statement 1 is correct)**
- Rotation introduces centrifugal forces, which counteract gravity at the equator. This results in an oblate spheroid shape rather than a perfect sphere. For example, Jupiter and Saturn, which rotate rapidly, exhibit noticeable equatorial bulges. **(Statement 2 is correct)**
- Statement-II provides additional information about the effect of rotation but does not explain why gravity shapes planets into spheres. Instead, it complements Statement-I by describing how rotational forces modify the ideal spherical shape.

Q.7) Consider the following regions:

1. Eistla Regio region

2. Niobe Planitia
3. Hellas Planitia

Which of the above region/s is/are located on the planet Venus?

a) 1 only
b) 1 and 2 only
c) 2 only
d) 2 and 3 only

Q.7) Solution (b)

Explanation:

- Eistla Regio is a volcanic highland region on Venus. It is characterized by numerous volcanic features, including large shield volcanoes and extensive lava flows. Eistla Regio highlights Venus' intense volcanic activity, one of the key features of the planet's geology. **(Statement 1 is correct)**
- Niobe Planitia is a vast lowland plain on Venus, primarily composed of volcanic and tectonic features. Like other plains on Venus, Niobe Planitia provides evidence of resurfacing events caused by extensive lava flows. **(Statement 2 is correct)**
- Hellas Planitia is a massive impact basin on Mars, one of the largest in the Solar System. It was formed by a large asteroid impact and is characterized by its enormous size and significant depth, with surface features influenced by wind and seasonal frost. **(Statement 3 is incorrect)**

Q.8) Developed by ISRO, PraVaHa is a software tool specifically designed to:

a) Analyze the aerodynamics and thermodynamics of aerospace vehicles.
b) Monitor satellite trajectories in geostationary orbit.
c) Simulate real-time communication between ground stations and satellites.
d) Predict solar radiation impacts on satellite components**.**

Q.8) Solution (a)

Explanation:

- PraVaHa, developed by ISRO, is a Computational Fluid Dynamics (CFD) software specifically designed for the aero-thermodynamic analysis of aerospace vehicles. This includes launch vehicles, re-entry vehicles (winged and non-winged), and other spacecraft. Features:
    - Simulates airflow around aerospace vehicles to understand aerodynamic forces and heat effects.
    - Helps design optimal shapes, structures, and Thermal Protection Systems (TPS) for these vehicles. **(Option (a) is correct)**
- Monitoring satellite trajectories, particularly for geostationary orbits, involves tools like the ISRO Telemetry, Tracking, and Command Network (ISTRAC), not PraVaHa.
- Real-time communication simulation is handled by software and systems designed for telemetry and satellite communication, such as those integrated into the GSAT series.
- The effects of solar radiation on satellite components, such as thermal loading or degradation of materials, are studied using separate simulation software like thermal analysis tools.

Q.9) Consider the following statements with respect to the ISRO's Reusable Launch Vehicle:

1. It can be used multiple times for space missions.
2. It is a winged vehicle that will take off like a rocket.
3. It requires a short runway of 500 metre to land.
4. It is a single stage rocket with extensive boost.

How many of the statements above are correct?

a) Only one
b) Only two
c) Only three
d) All four

Q.9) Solution (b)

Explanation:

- The Reusable Launch Vehicle (RLV) is designed to be used multiple times, similar to the SpaceX Falcon rockets or NASA's Space Shuttle. This reduces the cost of space missions by reusing the vehicle for multiple launches, which is a key step toward sustainable and economical space exploration.
- ISRO's RLV is a winged vehicle designed to take off vertically like a rocket and re-enter the atmosphere at high speeds, using its aerodynamic structure for controlled descent. This hybrid approach combines the vertical launch of rockets with the horizontal landing capability of aircraft. **(Option (b) is correct)**
- The RLV requires a longer runway for landing. For example, the experimental landing tests are conducted on runways exceeding 2 km in length. A short runway of 500 metres is insufficient for a safe landing at the high speeds involved during re-entry.
- The RLV is not a single-stage vehicle but a test platform for reusable technologies that can be incorporated into multi-stage launch vehicles. Single-stage-to-orbit (SSTO) technology is still a goal for future developments but is not implemented in ISRO's current RLV program.

Q.10) Which one of the following is not one of the categories of communication satellites?

a) Geostationary Earth orbit
b) Medium Earth orbit
c) Low Earth orbit
d) Lagrange 1 orbit

Q.10) Solution (d)

Explanation:

- Satellites in Geostationary Earth Orbit are positioned about 35,786 km above Earth's equator. They orbit at the same speed as the Earth's rotation, making them appear stationary relative to a specific point on Earth. This is ideal for communication satellites like weather monitoring, broadcasting, and telecommunications (e.g., GSAT satellites by ISRO).
- Satellites in Medium Earth Orbit operate at altitudes between 2,000 km and 35,786 km. These orbits are commonly used for navigation systems like GPS (Global

Positioning System), GLONASS, and Galileo, as well as some communication applications.

- Satellites in Low Earth Orbit operate at altitudes between 160 km and 2,000 km. They are commonly used for Earth observation, remote sensing, and satellite internet constellations like Starlink and OneWeb. Communication satellites in LEO provide low-latency services and are suitable for high-speed internet.
- Lagrange points are positions in space where the gravitational forces of two large bodies (e.g., Earth and the Sun) balance the centrifugal force felt by a smaller object. While spacecraft like solar observatories (ISRO's Aditya-L1 at L1) are positioned at these points, they are not used for communication purposes. **(Option (d) is correct)**

Q.11) Consider the following:

1. Panspermia Hypothesis
2. Miller-Urey Experiment
3. Oparin-Haldane Hypothesis

Which of the theories given above is/are considered to be various theories of life's origin?

a) 1 only
b) 1 and 2 only
c) 2 and 3 only
d) 1, 2 and 3

Q.11) Solution (d)

Explanation:

- The Panspermia Hypothesis suggests that life originated elsewhere in the universe and was transported to Earth via meteoroids, comets, or interstellar dust. It proposes that the building blocks of life or even microorganisms might have survived the harsh conditions of space and seeded life on Earth.
- Conducted in 1953 by Stanley Miller and Harold Urey, this experiment simulated the early Earth's atmospheric conditions. By passing electric sparks (to simulate lightning) through a mixture of gases (methane, ammonia, hydrogen, and water vapor), they produced amino acids, the building blocks of proteins. This experiment provided experimental evidence for chemical evolution as a precursor to biological life.
- Proposed independently by Aleksandr Oparin and J.B.S. Haldane, this hypothesis posits that life originated through a series of chemical reactions in Earth's early

atmosphere, which was rich in methane, ammonia, and water vapor. These reactions, powered by energy sources like UV radiation and lightning, led to the formation of simple organic compounds, which eventually evolved into complex molecules and life forms. **(Option (d) is correct)**

Q.12) In context of space science, what do you understand by the term 'Dyson spheres'?

a) A dense region of dark matter around the center of galaxies.
b) Hypothetical megastructures built around a star to harness its energy.
c) A phenomenon where light bends around massive celestial bodies.
d) A type of exoplanet that emits more infrared radiation than visible light.

Q.12) Solution (b)

Explanation:

- Dark matter halos are theoretical constructs to explain the observed rotational speeds of galaxies, which cannot be accounted for by visible matter alone.
- The concept of Dyson Spheres was proposed by physicist and mathematician Freeman Dyson in 1960. These are hypothetical structures that a highly advanced civilization could construct around a star to capture and utilize its entire energy output. Variations include a solid shell (impractical due to stability issues) or a swarm of solar-collecting satellites orbiting the star.
- These structures are often considered in the context of the Kardashev Scale, which classifies civilizations based on their energy usage. A Dyson Sphere would be indicative of a Type II civilization capable of harnessing the full energy of its star. **(Option (b) is correct)**
- Gravitational lensing is a phenomenon predicted by Einstein's theory of general relativity. It occurs when light from a distant object, like a star or galaxy, bends due to the gravitational influence of a massive body (e.g., a black hole or galaxy cluster) between the source and the observer.

Hot Jupiters are exoplanets that orbit very close to their parent stars and have extremely high temperatures. Their atmospheres often emit more infrared radiation than visible light due to thermal heating.

Q.13) Consider the following statements with respect to Mars:

1. Its surface looks red because iron minerals oxidise in the Martian atmosphere.

2. It has six small moons.
3. Hope Mars Mission is a mars mission by Isreal.

How many of the statements above are correct?

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

Q.13) Solution (a)

Explanation:

- Mars is known as the "Red Planet" because of the reddish hue of its surface, which is due to iron-rich minerals that oxidize (rust) when exposed to trace amounts of oxygen in the Martian atmosphere or from ancient interactions with water. This gives the soil its characteristic red color. **(Option (a) is correct)**
- Mars has only two moons, Phobos and Deimos, both of which are small and irregularly shaped. These moons are thought to be captured asteroids from the nearby asteroid belt.
- The Hope Mars Mission is the United Arab Emirates (UAE)'s first interplanetary mission, not Israel's. Launched in 2020, the mission focuses on studying the Martian atmosphere, weather patterns, and climate dynamics. Israel does not have a Mars mission to date.
- Other notable missions include NASA's Perseverance Rover, China's Tianwen-1, and India's Mangalyaan (Mars Orbiter Mission).

Q.14) With respect to Neutrinos, identify the *incorrect* statement from the following:

a) They are subatomic particles that have no electric charge.
b) They interact with regular matter extensively.
c) They can carry information across large distances.
d) Electron-neutrino, muon-neutrino and tau-neutrino are its types.

Q.14) Solution (b)

Explanation:

- Neutrinos are fundamental subatomic particles with no electric charge and an extremely small mass. They belong to the family of leptons and interact only via the weak nuclear force and gravity, making them neutral and elusive.
- Neutrinos interact very weakly with matter, which makes them extremely difficult to detect. They can pass through vast amounts of matter (e.g., the entire Earth) without any interaction. This is because they interact only via the weak nuclear force and gravity, unlike charged particles that also interact electromagnetically. **(Option (b) is correct)**
- Due to their weak interaction with matter, neutrinos can travel vast distances without being absorbed or scattered, carrying valuable information about their sources. For example, neutrinos from the Sun, supernovae, or distant galaxies provide insights into astrophysical processes.
- Neutrinos exist in three types or flavors: electron-neutrino, muon-neutrino, and tau-neutrino, corresponding to the three charged leptons (electron, muon, and tau). These neutrino flavors can oscillate, or change type, as they travel, a phenomenon that provided the first evidence of neutrino mass.

Q.15) In context of new space missions, the Jupiter Icy Moons Explorer (JUICE) Probe is by which of the following organisations?

a) National Aeronautics and Space Administration
b) Japan Aerospace Exploration Agency
c) China National Space Administration
d) European Space Agency

Q.15) Solution (d)

Explanation:

- While NASA has significant missions related to Jupiter, such as the Juno spacecraft, the JUICE mission is not led by NASA. However, NASA provides collaboration and support for JUICE, including scientific instruments.
- JAXA is not the primary organization for the JUICE mission. Japan has its own space exploration programs, including asteroid missions like Hayabusa and plans for lunar and Martian exploration.

- CNSA is not involved in the JUICE mission. China's space exploration efforts are currently focused on the Moon (e.g., Chang'e program) and Mars (e.g., Tianwen-1 mission). While CNSA is expanding its scope, it does not lead the JUICE project.
- The Jupiter Icy Moons Explorer (JUICE) mission is led by the European Space Agency (ESA). Scheduled for launch in 2023, it is designed to study Jupiter's three largest icy moons: Ganymede, Europa, and Callisto, which are believed to harbor subsurface oceans. JUICE will investigate their habitability and their interaction with Jupiter's magnetosphere. **(Option (d) is correct)**

Q.16) Consider the following statements with respect to the Smart Lander for Investigating Moon (SLIM):

1. It is a small-scale lunar lander designed for precise landings.
2. It is an initiative of Japan's space agency, JAXA.

Which of the statements given above is/are correct?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Q.16) Solution (c)

Explanation:

- The Smart Lander for Investigating Moon (SLIM) is a small lunar lander developed to demonstrate precision landing technologies. Unlike traditional landers, SLIM focuses on landing within 100 meters of a targeted location, a significant improvement in accuracy. This capability is critical for future lunar exploration missions, particularly for landing in rugged or scientifically important regions.
- SLIM is a mission of Japan Aerospace Exploration Agency (JAXA). Japan aims to strengthen its position in lunar exploration with this mission, leveraging innovative technologies for precise landings. JAXA's initiatives often emphasize technological demonstrations that pave the way for international collaborations and future missions. **(Option (c) is correct)**

Q.17) With reference to the RHUMI-1, consider the following features:

1. Hybrid Propulsion System
2. Adjustable Launch Angle
3. Electrically Triggered Parachute System

Which of the statement above is/are correct?

a) 1 only
b) 2 only
c) 1 and 3 only
d) 1, 2 and 3

Q.17) Solution (d)

Explanation:

- The RHUMI-1 rocket uses a hybrid propulsion system, which integrates both solid and liquid propellants. This system is more efficient than traditional rocket engines and reduces operational costs. The hybrid design also allows for better control over thrust and combustion, making it a versatile choice for reusable rockets.
- RHUMI-1 features an adjustable launch angle mechanism, allowing the rocket's trajectory to be precisely controlled. The engine supports angle adjustments from 0 to 120 degrees, making it suitable for a range of mission objectives. This capability enhances the rocket's flexibility and adaptability for various research purposes.

The rocket incorporates an electrically triggered parachute system, ensuring safe recovery of rocket components after the mission. This eco-friendly mechanism eliminates the use of pyrotechnics or explosives, making it a sustainable solution for reusable rockets. **(Option (d) is correct)**

Q.18) Consider the following statements:

1. Helium is the lightest element in the periodic table.
2. Helium is a stable, non-reactive noble gas.
3. It has a very high boiling point.

How many of the statements above are correct?

a) Only one

b) Only two
c) All three
d) None

Q.18) Solution (a)

Explanation:

- Helium is not the lightest element; hydrogen holds this distinction. Hydrogen, with an atomic number of 1, is the simplest and lightest element, while helium, with an atomic number of 2, is the second lightest.
- Helium is a noble gas and is extremely stable due to its full valence electron shell (two electrons in the outer shell). It does not form compounds under normal conditions, making it inert and non-reactive. Helium's stability is why it is used in applications requiring non-reactive environments, such as in cryogenics or as a lifting gas in balloons. **(Option (a) is correct)**
- Helium has one of the lowest boiling points of all elements, at approximately -268.9°C (4.2 K). This is due to its weak intermolecular forces and small atomic size, making it ideal for use in cryogenics and as a coolant for superconducting magnets in applications like MRI machines.

Q.19) In context of defence technologies, what do you understand by 'CALM System'?

a) A coastal area surveillance platform using autonomous underwater vehicles for anti-submarine operations.
b) A pre-loaded canister system containing loiter munitions capable of hovering and striking targets once identified.
c) A counter-artillery laser module designed to neutralize incoming mortar and artillery shells mid-air.
d) A computer-assisted landmine mapping system employed to detect and safely neutralize buried explosive devices.

Q.19) Solution (b)

Explanation:

- While autonomous underwater vehicles (AUVs) are used in anti-submarine warfare to detect enemy submarines and map the ocean floor, the CALM System is not related to underwater or anti-submarine operations
- A CALM (Canister Launched Loiter Munition) System typically comes in a sealed, ready-to-use canister, making it quickly deployable. Once launched, the munition can be guided to its target, combining the surveillance capabilities of a drone with the offensive power of a missile. Loiter munitions are essentially "kamikaze drones" that can hover over an area for an extended period and strike when a suitable target is located. **(Option (b) is correct)**
- Laser-based defence systems exist to neutralize incoming projectiles (for example, the HEL (High Energy Laser) systems), but the CALM System described is not a directed-energy weapon nor does it utilize lasers to intercept incoming fire. Landmine detection and clearing technology often involves mapping techniques, ground-penetrating radar, or robotic systems to ensure safe clearance

Q.20) Consider the following statements with reference to the Naval Innovation and Indigenisation Organisation (NIIO):

1. It was launched in August 2020.
2. It provides a flexible and accessible interface for academia and industry with Indian Navy.

Which of the statements above is/are correct?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Q.20) Solution (c)

Explanation:

- The Naval Innovation and Indigenisation Organisation (NIIO) was formally launched by the Indian Navy in August 2020. The NIIO was established to drive the Navy's efforts

toward self-reliance (Aatmanirbhar Bharat) in defence manufacturing and to foster an ecosystem that nurtures innovation.

- One of the key objectives of NIIO is to streamline the Indian Navy's interaction with industry and academia, including startups and MSMEs. By doing so, it seeks to accelerate the process of idea generation, prototyping, and product development. This approach encourages joint research, technology development, and capability enhancement in a transparent and user-friendly manner. **(Option (c) is correct)**

Q.21) In context of defence technologies, what do you understand by 'CALM System'?

e) A coastal area surveillance platform using autonomous underwater vehicles for anti-submarine operations.
f) A pre-loaded canister system containing loiter munitions capable of hovering and striking targets once identified.
g) A counter-artillery laser module designed to neutralize incoming mortar and artillery shells mid-air.
h) A computer-assisted landmine mapping system employed to detect and safely neutralize buried explosive devices.

Q.21) Solution (b)

Explanation:

- While autonomous underwater vehicles (AUVs) are used in anti-submarine warfare to detect enemy submarines and map the ocean floor, the CALM System is not related to underwater or anti-submarine operations
- A CALM (Canister Launched Loiter Munition) System typically comes in a sealed, ready-to-use canister, making it quickly deployable. Once launched, the munition can be guided to its target, combining the surveillance capabilities of a drone with the offensive power of a missile. Loiter munitions are essentially "kamikaze drones" that can hover over an area for an extended period and strike when a suitable target is located. **(Option (b) is correct)**
- Laser-based defence systems exist to neutralize incoming projectiles (for example, the HEL (High Energy Laser) systems), but the CALM System described is not a directed-energy weapon nor does it utilize lasers to intercept incoming fire.
- Landmine detection and clearing technology often involves mapping techniques, ground-penetrating radar, or robotic systems to ensure safe clearance.

Q.22) Consider the following statements with reference to the Naval Innovation and Indigenisation Organisation (NIIO):

3. It was launched in August 2020.

4. It provides a flexible and accessible interface for academia and industry with Indian Navy.

Which of the statements above is/are correct?

e) 1 only
f) 2 only
g) Both 1 and 2
h) Neither 1 nor 2

Q.22) Solution (c)

Explanation:

- The Naval Innovation and Indigenisation Organisation (NIIO) was formally launched by the Indian Navy in August 2020. The NIIO was established to drive the Navy's efforts toward self-reliance (Aatmanirbhar Bharat) in defence manufacturing and to foster an ecosystem that nurtures innovation.
- One of the key objectives of NIIO is to streamline the Indian Navy's interaction with industry and academia, including startups and MSMEs. By doing so, it seeks to accelerate the process of idea generation, prototyping, and product development. This approach encourages joint research, technology development, and capability enhancement in a transparent and user-friendly manner. **(Option (c) is correct)**

Q.23) Consider the following statements:

1. Comprehensive Nuclear Test Ban Treaty (CTBT) is a multilateral treaty aimed at banning all nuclear explosions.
2. The ban excludes nuclear explosions for peaceful purposes.
3. India has signed and ratified the CTBT.

Which of the statements given above is/are correct?

a) 1 only
b) 1 and 2 only
c) 2 and 3 only
d) 1, 2 and 3

Q.23) Solution (a)

Explanation:

- The CTBT is a multilateral treaty that prohibits all nuclear explosions, regardless of their purpose—whether for military or peaceful applications. It aims to constrain the

development of nuclear weapons and promote nuclear disarmament. The treaty was adopted by the United Nations General Assembly on 10 September 1996 and aims to ensure a legally binding global ban on nuclear testing. **(Option (a) is correct)**

- The CTBT explicitly bans all nuclear explosions, whether for military or peaceful purposes. There are no exceptions to this prohibition under the treaty's framework. The Partial Test Ban Treaty (PTBT) of 1963 allowed peaceful nuclear explosions, but the CTBT closed this loophole.
- India has neither signed nor ratified the CTBT. India has raised concerns about the treaty's discriminatory nature, as it does not require nuclear weapons states to disarm and instead institutionalizes their nuclear privileges. India insists on a universal, non-discriminatory, and verifiable disarmament framework.

Q.24) With respect to 'Project Kusha', consider the following statements:

1. It is aimed at developing India's long-range air defence system by 2028-29.
2. It will consist of three types of interceptor missiles.
3. It is being spearheaded by Hindustan Aeronautics Limited (HAL).

How many of the statements above are correct?

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

Q.24) Solution (b)

Explanation:

- Project Kusha is a defence initiative led by the Defence Research and Development Organisation (DRDO) to develop a long-range air defence system by 2028-29. The system aims to detect and neutralize advanced enemy threats such as cruise missiles, stealth fighters, and drones at long ranges.
- Project Kusha envisions the development of three types of interceptor missiles with ranges of 150 km, 250 km, and 350 km. These missiles will be integrated with advanced long-range surveillance and fire control radar systems, providing a robust multi-layered air defence capability. **(Option (b) is correct)**
- Project Kusha is being led by the Defence Research and Development Organisation (DRDO), not Hindustan Aeronautics Limited (HAL). While HAL plays a crucial role in defence aviation, the development of air defence systems and missiles falls under DRDO's purview.

Q.25) Consider the following statements with reference to the Light Combat Helicopter (LCH):

1. It is a below 10-tonne class dedicated combat helicopter.
2. It uses radar-absorbing material to lower radar signature.
3. It has a combat radius of 5000 km.
4. It is powered by two Indian-origin Shakti engines.

How many of the statements above are correct?

a) Only one
b) Only two
c) Only three
d) All four

Q.25) Solution (b)

Explanation:

- The Light Combat Helicopter (LCH), developed by Hindustan Aeronautics Limited (HAL), falls in the 5-8 tonne class. It was designed specifically to meet the needs of high-altitude combat operations, conceptualized after the 1999 Kargil conflict. It is a dedicated combat helicopter, capable of operating in extreme altitudes, unlike multipurpose helicopters.
- The LCH incorporates radar-absorbing material to reduce its radar signature, enhancing its stealth capabilities. This is a significant feature that increases survivability in combat scenarios by making it harder for enemy radars to detect. **(Option (b) is correct)**
- The LCH has a combat radius of 500 km, not 5000 km. A combat radius of 500 km aligns with its operational role for high-altitude and close-combat missions, which require agility and shorter range.
- The LCH is powered by two French-origin Shakti engines, which are co-developed by HAL and Turbomeca (now Safran Helicopter Engines). While the engines are manufactured in India by HAL, they are not fully Indian in origin.
- The LCH is the only attack helicopter in the world capable of operating at altitudes as high as 5,000 m (16,400 ft), making it ideal for high-altitude conflict zones like the Siachen Glacier and the Himalayan border areas.
- The LCH is armed with advanced weaponry, including anti-tank guided missiles, air-to-air missiles, rockets, and a 20 mm nose gun. It also has features like crash-proof structure, countermeasure dispensing systems, and a pressurized cabin for NBC protection.

Q.26) With respect to the 'Agni-1' missile, identify the *incorrect* statement from the following statements:

a) It has the capability to carry both conventional and nuclear warheads.
b) It is a single-stage, solid-fueled missile.
c) It is designed to be a strategic weapon capable.
d) It has a range of above 2500km and can carry a payload of 5,000 kg.

Q.26) Solution (d)

Explanation:

- Agni-1 is capable of carrying both conventional and nuclear warheads, with a payload capacity of up to 1,000 kg. This dual capability makes it a versatile and strategic weapon in India's missile arsenal.
- The Agni-1 missile is a single-stage, solid-fuelled missile. Solid-fuel technology offers rapid deployment and greater stability compared to liquid-fuel systems, making it an efficient and reliable ballistic missile.
- Agni-1 is designed as a strategic weapon in India's missile program. Its role is aligned with India's nuclear doctrine of credible minimum deterrence and the ability to deter regional adversaries.
- The Agni-1 missile has a range of 700–900 km, not above 2500 km. Its payload capacity is approximately 1,000 kg, far below the stated 5,000 kg. The range and payload described in this option are closer to those of Agni-IV or Agni-V missiles, which are designed for intermediate or long-range targets. **(Option (d) is incorrect)**

Q.27) Consider the following:

1. Pinaka system
2. Tejas mk-2 jet
3. Dhruv helicopter

Which of the systems given above is/are developed by Defence Research and Development Organisation (DRDO)?

a) 1 only
b) 2 only
c) 2 and 3 only
d) 1 and 3 only

Q.27) Solution (a)

Explanation:

- The Pinaka Multi-Barrel Rocket Launcher (MBRL) system is developed by the Defence Research and Development Organisation (DRDO). It is an indigenous system designed to provide artillery support with high mobility and rapid-fire capabilities.
- Pinaka can launch rockets up to 75 km (enhanced version) and is used by the Indian Army. This system is a testament to DRDO's focus on strengthening India's artillery capabilities with indigenous technology. **(Option (a) is correct)**
- The Tejas Mk-2 jet is being developed by Hindustan Aeronautics Limited (HAL), not DRDO. HAL is responsible for the production and development of this advanced version of the Light Combat Aircraft (LCA) Tejas.
- While DRDO, through its subsidiary Aeronautical Development Agency (ADA), was involved in the initial design of the Tejas LCA, the Mk-2 variant is HAL's project. Tejas Mk-2 is designed as an advanced multirole fighter with improved avionics, weapon capacity, and range.
- The Dhruv Advanced Light Helicopter (ALH) is developed by Hindustan Aeronautics Limited (HAL), not DRDO. HAL is India's premier aerospace manufacturer and has been the primary organization responsible for helicopter design and production. Dhruv is a versatile utility helicopter used by the Indian Army, Air Force, Navy, and Coast Guard for transport, reconnaissance, and rescue missions.

Q.28) Recently seen in news, the Vijay Raghavan panel is associated with which of the following options:

a) Suggesting reforms in India's cybersecurity framework.
b) Recommending steps to improve India's nuclear energy program.
c) Reviewing the functioning of the Defence Research and Development Organisation.
d) Assessing the potential of Artificial Intelligence in Defence.

Q.28) Solution (c)

Explanation:

- The Kris Gopalakrishnan committee was tasked with recommending measures to regulate non-personal data and enhancing India's cybersecurity framework.
- The Homi Bhabha Committee, established in the mid-20th century, laid the foundation for India's nuclear energy program and the establishment of the Department of Atomic Energy (DAE).
- The Vijay Raghavan panel, a nine-member government-appointed committee, recently submitted its report to address concerns about DRDO's functioning. The panel's mandate includes identifying delays in defence R&D projects, inefficiencies in resource allocation, and methods to improve innovation and project delivery. DRDO plays a key

role in India's indigenous defence production, and its reform is essential for achieving self-reliance under Atmanirbhar Bharat. **(Option (c) is correct)**

- The N Chandrasekaran Task Force was formed to evaluate the adoption of Artificial Intelligence (AI) in the defence sector. The task force provided recommendations on how AI can enhance operational capabilities, automate defence production, and strengthen India's military edge.

Q.29) Consider the following statements regarding High Altitude Pseudo-Satellites (HAPS):

1. HAPS operates in the mesosphere, enabling it to provide surveillance capabilities that exceed those of low-earth orbit (LEO) satellites.
2. Unlike satellites, HAPS relies on solar power and can be deployed for prolonged missions without requiring re-launch or refueling.
3. HAPS has an advantage over traditional UAVs due to its ability to remain stationary in one position over strategic locations.

Which of the statements given above is/are correct?

a) 1 and 2 only
b) 2 and 3 only
c) 1 and 3 only
d) 1, 2, and 3

Q.29) Solution (b)

Explanation:

- HAPS operates in the stratosphere (18–20 km above Earth's surface), not the mesosphere (50–85 km). It complements low-earth orbit (LEO) satellites but cannot exceed their coverage in terms of altitude.
- HAPS is solar-powered, allowing it to stay airborne for weeks, months, or even years. Unlike satellites, which require expensive rocket launches, HAPS is deployable and retrievable at significantly lower costs.
- HAPS can hover or remain stationary over a fixed location in the stratosphere, which is a key advantage over conventional UAVs, whose range and endurance are limited by fuel or battery capacity. **(Option (b) is correct)**

Q.30) With reference to the Multiple Independently Targetable Re-entry Vehicle (MIRV), consider the following statements:

1. MIRV allows a single missile to carry multiple warheads, each capable of targeting different locations independently.
2. Only USA, Russia and China have developed the MIRV technology.

Which of the statements above is/are correct?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Q.30) Solution (a)

Explanation:

- A Multiple Independently Targetable Re-entry Vehicle (MIRV) is a ballistic missile payload that can deliver multiple nuclear warheads to several distinct targets. Once the missile reaches space, the warheads can be deployed and guided (to a degree) individually toward separate targets. **(Option (a) is correct)**
- A single MIRV-equipped missile can release multiple warheads. Each warhead then follows its own trajectory to strike different targets, thereby multiplying the missile's overall destructive capability and complicating enemy missile defence efforts. The U.S. Minuteman III ICBM, for instance, can carry multiple warheads, each targeted at different objectives.
- The United States and the Soviet Union (now Russia) were the pioneers in developing and deploying MIRV technology during the Cold War. China has also developed MIRV capabilities in more recent years.
- Beyond these three, other nuclear-armed states such as the United Kingdom and France have developed submarine-launched ballistic missiles (SLBMs) with MIRV capabilities. India has also indicated advancements in MIRV technology for its Agni missiles, though full operational deployment status may vary.

Q.31) Consider the following statements with respect to the Positive Indigenisation List (PIL) for defence procurements in India:

1. It is a list of items that can only be purchased by the Indian armed forces from domestic manufacturers.
2. It excludes private manufacturers from its ambit.
3. The lists are notified by the Department of Military Affairs (DMA).

How many of the statements above are correct?

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

Q.31) Solution (b)

Explanation:

- The Positive Indigenisation List (PIL) is a set of equipment and platforms that the Indian armed forces will procure only from domestic sources after a specified timeline. This is part of the government's strategy to reduce imports, promote self-reliance, and strengthen the indigenous defence manufacturing ecosystem.
- The PIL is not limited to public sector enterprises like the Defence Public Sector Undertakings (DPSUs) or the Ordnance Factory Board (now the 7 new DPSUs). It aims to foster indigenisation within the entire Indian defence industry ecosystem, which includes both public and private sector manufacturers. In fact, the private sector is actively encouraged to participate, innovate, and supply items listed in the PIL.
- The Department of Military Affairs (DMA), headed by the Chief of Defence Staff (CDS), is responsible for ensuring coordination and reforms in defence procurement and indigenisation initiatives. The Positive Indigenisation Lists are indeed notified and promulgated through the DMA as part of the broader 'Aatmanirbhar Bharat' (self-reliant India) defence push. **(Option (b) is correct)**

Q.32) With respect to India's nuclear-powered ballistic missile submarines (SSBN), consider the following statements:

1. India currently has two SSBNs operational.
2. They are also called hunter-killers.
3. INS Arighaat is India's first SSBN.

Which of the statements given above is/are correct?

a) 1 only
b) 2 and 3 only
c) 1 and 3 only
d) 1, 2 and 3

Q.32) Solution (a)

Explanation:

- India commissioned its first SSBN, INS Arihant, into service in August 2016. The second SSBN, INS Arighaat, was commissioned at the end of August 2024, according to the given information. Thus, as of now, India has two operational SSBNs: INS Arihant and INS Arighaat. **(Option (a) is correct)**
- There are two types of nuclear-powered submarines:
    - **SSBN (Ship Submersible Ballistic Nuclear):** These are ballistic missile submarines primarily designed for strategic deterrence by carrying submarine-launched ballistic missiles (SLBMs).

- **SSN (Ship Submersible Nuclear)**: These are nuclear-powered attack submarines, often referred to as "hunter-killers," as their primary role is to hunt and destroy enemy submarines and surface ships, and perform other tactical missions.

- SSBNs are not generally called "hunter-killers"; that term applies to SSNs (Nuclear Attack Submarines).
- India's first SSBN is INS Arihant, commissioned in 2016. INS Arighaat is the second SSBN. Thus, INS Arighaat is not the first SSBN.

Q.33) With reference to the Anti-Personnel Landmines Convention,1997, identify the incorrect statement from the following statements:

a) It is also known as the Ottawa Convention or the Anti-Personnel Mine Ban Treaty.
b) It prohibits the use, production, stockpiling, and transfer of anti-personnel landmines.
c) It covers both anti-personnel and anti-vehicle mines.
d) It entered into force on 1st March 1999 after the requisite number of ratifications.

Q.33) Solution (c)

Explanation:

- The Anti-Personnel Landmines Convention,1997 is an international agreement that aims to eliminate the use, production, stockpiling, and transfer of anti-personnel landmines. It is commonly referred to as the Ottawa Convention or Anti-Personnel Mine Ban Treaty.
- Under the treaty's provisions, States Parties agree to destroy their stockpiles of anti-personnel mines within four years and clear mined areas under their jurisdiction or control within ten years.
- This comprehensive approach addresses both the future threat (production and transfer) and the existing legacy of contamination (stockpiles and minefields). Many countries have successfully destroyed millions of stockpiled mines, showcasing the treaty's tangible humanitarian and disarmament impact.
- The Anti-Personnel Landmines Convention (also known as the Ottawa Convention) applies exclusively to anti-personnel mines. It defines anti-personnel mines as devices designed to explode due to the presence, proximity, or contact of a person, thus primarily targeting humans.
- The text of the treaty clearly focuses on anti-personnel mines. Its central goal is to address the humanitarian crisis caused by these mines—tools that indiscriminately injure or kill civilians long after conflicts end. The treaty does not ban or regulate anti-vehicle (often called anti-tank) mines. **(Option (c) is correct)**
- The treaty entered into force on March 1, 1999, less than two years after it was concluded, reflecting widespread global support. Such a swift entry into force is noteworthy in international law, indicating strong international consensus on the humanitarian imperative to outlaw these weapons. As of now, 164 States are Parties

to the Convention, showcasing near-universal acceptance, although some major powers have not joined. This participation level underscores the treaty's role in shaping global norms against the use of anti-personnel mines.

Q.34) Recently seen in news, Eklavya, an online learning platform, was launched by which of the following ministries?

a) Ministry of Education
b) Ministry of Finance
c) Ministry of Commerce
d) Ministry of Defence

Q.34) Solution (d)

Explanation:

- While the Ministry of Education focuses on e-learning and digital platforms like DIKSHA and SWAYAM, it is not responsible for launching Eklavya. DIKSHA is a digital infrastructure for school education offering e-content to teachers and students while SWAYAM is an online learning platform offering Massive Open Online Courses (MOOCs) for higher education.
- The Ministry of Finance manages fiscal policies, budgeting, and economic regulations but is not involved in defence education platforms. Platforms like PRAGATI for monitoring government projects or initiatives related to financial inclusion (e.g., PMJDY, UPI).
- The Ministry of Commerce does not focus on defence-related training or education platforms. Focus areas include Ease of Doing Business, Start-Up India, and export promotion initiatives. Platforms like GeM (Government e-Marketplace) and INSTANT focus on trade facilitation, not education or defence.
- The Ministry of Defence launched the "Eklavya" online learning platform specifically designed for the Indian Army. It enhances professional education and training for Indian Army officers. It is part of the Decade of Transformation (2023-2032) initiative.
- It is created by Bhaskarcharya National Institute of Space Applications and Geoinformatics (BISAG-N), Gandhinagar and includes 96 courses hosted by 17 Category 'A' Training Establishments of the Indian Army. **(Option (d) is correct)**

Q.35) Consider the following statements:

1. INS Tushil is a frigate of the Talwar Class.
2. It is an indigenously developed frigate at the Mazagaon Docks.
3. A frigate is a versatile warship used for multiple operation.

How many of the statements above are correct?

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

Q.35) Solution (b)

Explanation:

- INS Tushil belongs to the Talwar Class, which is part of the Krivak III-class frigates under Project 1135.6. It is the 7th frigate in this series, following three Talwar-class and three Teg-class frigates. The Talwar Class frigates are known for their stealth features, advanced weapon systems, and multipurpose roles.
- INS Tushil is not indigenously developed at the Mazagaon Docks. It was built in Russia under a 2016 contract between the Indian Government and JSC Rosoboronexport, a Russian defense exporter. While India is focusing on indigenous shipbuilding through initiatives like the Nilgiri-class frigates and the Vikrant aircraft carrier, INS Tushil was built in Russia.
- A frigate is indeed a versatile warship designed for escort, patrolling, and combat operations. Frigates play a key role in protecting maritime assets, escorting larger ships, and ensuring the safety of sea lines of communication. Their flexibility makes them an indispensable part of modern navies, especially for nations like India with extensive maritime borders. **(Option (b) is correct)**

Q.36) Consider the following statements:

1. Hybrid warfare refers to a combination of kinetic warfare and non-kinetic warfare.
2. Non-kinetic warfare includes using conventional military tactics and strategies.

Which of the statements above is/are correct?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Q.36) Solution (a)

Explanation:

- Hybrid warfare involves the simultaneous use of kinetic (physical/military) and non-kinetic (psychological, cyber, economic, and informational) tactics to achieve strategic objectives. **(Option (a) is correct)**

- Kinetic Warfare refers to traditional military operations, such as armed combat, bombings, and troop deployment.
- Non-Kinetic Warfare includes cyber-attacks, disinformation campaigns, economic coercion, and psychological warfare aimed at destabilizing the enemy without physical conflict.

Q.37) Consider the following products:

1. Pinaka rocket system
2. Brahmos missile system
3. T-90 tank
4. Heron UAVs

Which of the products above is/are part of India's defence exports?

a) 1 and 2 only
b) 2 and 3 only
c) 3 and 4 only
d) 1 and 4 only

Q.37) Solution (a)

Explanation:

- Pinaka Rocket System is an indigenously developed multiple rocket launcher system by DRDO, Pinaka is a key defence export of India. It has been exported to countries like Armenia, showcasing India's capability in producing advanced artillery systems.
- BrahMos Missile System is a jointly developed by India and Russia, the supersonic cruise missile is a flagship export product. Recently, it was exported to the Philippines, marking a significant milestone in India's defence exports. **(Option (a) is correct)**
- T-90 Tanks are of Russian origin and imported by India under license. As a result, they are not part of India's defence exports.

Heron UAVs are Israeli-made drones imported by India for surveillance and thus not exported by India.

Q.38) Consider the following statements:

1. The Hypersonic Glide Vehicles (HGVs) and Hypersonic Cruise Missiles (HCMs) are two types of hypersonic weapons systems.
2. HCMs follow a fixed flight path and trajectory.
3. No hypersonic weapons systems have been used live in a conflict.

How many of the statements above are correct?

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

Q.38) Solution (a)

Explanation:

- Hypersonic weapons are broadly classified into two types:
  - Hypersonic Glide Vehicles: These are launched via a rocket and then glide through the atmosphere at hypersonic speeds, following unpredictable paths.
  - Hypersonic Cruise Missiles: These use advanced scramjet engines to sustain hypersonic speeds during cruise flight within the atmosphere. **(Option (a) is correct)**
- Hypersonic Cruise Missiles do not follow a fixed flight path. Unlike ballistic missiles, they are highly maneuverable and can adjust their trajectories during flight, making them harder to intercept and detect.
- Hypersonic weapons have been used in live conflicts. Russia used its Kinzhal hypersonic missile in the Ukraine conflict in 2022, marking one of the first uses of hypersonic weapons in warfare.

Q.39) With reference to the Aditi scheme, consider the following statements:

1. It promotes innovations in critical and strategic defence technologies.
2. Under the scheme, start-ups are eligible to receive grant-in-aid of up to Rs 25 crore for all purposes.
3. It aims to develop about 30 deep-tech critical and strategic technologies.

Which of the statements given above is/are correct?

a) 1 only
b) 1 and 2 only
c) 1 and 3 only
d) 2 and 3 only

Q.39) Solution (c)

Explanation:

- The ADITI (Acing Development of Innovative Technologies with iDEX) scheme explicitly aims to promote innovations in critical and strategic defence technologies. This aligns

with India's focus on advancing its defence ecosystem and fostering technological independence.

- While start-ups are eligible for grants under the ADITI scheme, the grant-in-aid of up to Rs 25 crore is specifically for research, development, and innovation endeavours in defence technology, not for all purposes.
- The scheme explicitly aims to develop 30 deep-tech critical and strategic technologies during the 2023-24 to 2025-26 period. This is a key objective under the iDEX framework to strengthen India's defence innovation ecosystem. **(Option (c) is correct)**

Q.40) Consider the following emissions:

1. Carbon monoxide
2. Black Carbon
3. Water vapour
4. Aluminium oxide

Which of the emissions given above is/are part of the significant emissions due to rockets launches?

a) 1 and 2 only
b) 2 and 3 only
c) 1, 3 and 4 only
d) 2, 3 and 4 only

Q.40) Solution (d)

Explanation:

- Rocket launches result in various emissions depending on the type of propellant used. Significant emissions include black carbon, water vapor, and Aluminium oxide, which have notable environmental impacts.
- While CO can be a byproduct of incomplete combustion, it is not a significant emission from rocket launches. The combustion processes in rocket engines are designed for high efficiency, leaving minimal amounts of CO.
- Black carbon (soot) is released from rocket engines, especially those using kerosene-based fuels like RP-1. It accumulates in the upper atmosphere, contributing to global warming and altering atmospheric dynamics. Rockets like the Falcon 9 (SpaceX) release black carbon particles that stay in the atmosphere for extended periods.
- Water vapor is a major emission, particularly from rockets using liquid hydrogen and liquid oxygen (LH2/LOX) as propellants. It accumulates in the stratosphere, impacting the ozone layer and contributing to global warming. Space Shuttle launches released large quantities of water vapor.
- Rockets using solid propellants emit aluminium oxide, which forms tiny particles. These particles can reflect sunlight, affect radiative forcing, and harm the ozone layer.

Solid rocket boosters, such as those used in the Space Shuttle, emit aluminium oxide as a major byproduct. **(Option (d) is correct)**

Q.41) Nuclear Fission and Nuclear Fusion are both processes used to generate nuclear energy.
Which one of the following statements is correct regarding the process of Nuclear Fusion and Nuclear Fission?

a) Nuclear fission releases energy by combining light nuclei, while nuclear fusion releases energy by breaking apart heavy nuclei.
b) Nuclear fission produces long-lived radioactive nuclear waste, while nuclear fusion does not create any long-lived radioactive nuclear waste.
c) Unlike Nuclear fusion, it is difficult to sustain nuclear fission for longer periods of time.
d) Nuclear fission reaction powers the sun while Nuclear fusion reaction powers the traditional nuclear power reactors.

Q.41) Solution (b)

Explanation:

- Fission is the splitting of a heavy, unstable nucleus into two lighter nuclei, and fusion is the process where two light nuclei combine together releasing vast amounts of energy. **Hence option a is incorrect.**
- Nuclear fission power plants have the disadvantage of generating unstable nuclei; some of these are radioactive for millions of years. Fusion on the other hand does not create any long-lived radioactive nuclear waste. **Hence option b is correct.**
- Nuclear fusion releases more energy than nuclear fission, but it is harder to achieve and sustain. The amount of energy released by a fusion reaction is proportional to the mass difference between the reactants and the products. Since the mass difference is larger for fusion than for fission, the energy output is also larger. Hence, the nuclear fusion is difficult to sustain because it requires extreme conditions to maintain the high temperatures and pressures needed for nuclear fusion to occur. **Hence option c is incorrect.**
- Nuclear Fusion reactions power the Sun and other stars. In a fusion reaction, two light nuclei merge to form a single heavier nucleus. The process releases energy because the total mass of the resulting single nucleus is less than the mass of the two original nuclei. The leftover mass becomes energy. **Hence option d is incorrect.**

Q.42) With reference to the location of nuclear power plants in India, consider the following pairs:

S.No	**Nuclear Power Plant**	**Location**
1.	Tarapur	Uttar Pradesh

2.	Kaiga	Maharashtra
3.	Kakrapar	Karnataka

How many of the above pairs are correctly matched?

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

Q.42) Solution (d)

Explanation:

- The Tarapur Atomic Power Station (T.A.P.S.) is situated in Tarapur, Maharashtra and holds the distinction of being the first commercial nuclear power station constructed in the country. The Plant has a current operational capacity of 1400 MW. **Hence Pair 1 is incorrectly matched.**
- Kaiga Nuclear reactor is located in Karnataka. It is located near the Kali River in the Uttara Kannada district of Karnataka. The plant is managed by the Nuclear Power Corporation of India with a current operational capacity of 880 MW. **Hence Pair 2 is incorrectly matched.**
- Kakrapar nuclear reactor is located in Gujarat. It has an operational capacity of 1840 MW. **Hence Pair 3 is incorrectly matched.**

Q.43) Which of the following statements correctly points to risks and issues associated with the production of nuclear energy?

1. Generation of harmful radioactive wastes.
2. Risk of occurrence of nuclear accidents
3. Difficulty in processing of used fuel.
4. Difficulty in storage of used fuel.

Select the correct answer using the code given below:

a) 1, 2 and 4 only
b) 2 and 4 only
c) 1, 2 and 3 only
d) 1, 2, 3 and 4

Q.43) Solution (a)

Explanation:

- Nuclear power is the use of nuclear reactions to produce electricity. Nuclear power is the second-largest source of low-carbon electricity today.
- A major environmental concern related to nuclear power is the creation of radioactive wastes such as uranium mill tailings, spent (used) reactor fuel, and other radioactive wastes. These materials can remain radioactive and dangerous to human health for thousands of years. **Hence Statement 1 is correct.**
- The nuclear accidents does not commonly occur, but when it happens, it can lead to significant consequences to people and the environment. The prime example of a "major nuclear accident" is one in which a reactor core is damaged and significant amounts of radioactive isotopes are released in air, such as in the Chernobyl disaster in 1986 and Fukushima nuclear disaster in 2011. **Hence Statement 2 is correct.**
- Used nuclear fuel has long been reprocessed to extract fissile materials for recycling and to reduce the volume of high-level wastes. A significant amount of plutonium recovered from used fuel is currently recycled into MOX fuel. **Hence Statement 3 is incorrect.**
- Storage and disposal of used fuel is a major hindrance in nuclear energy. Used nuclear fuel is kept in either wet or dry storage facilities, before being recycled or disposed of. When used fuel is taken out of a reactor, it is both hot and radioactive and requires storage in water to allow the fuel to cool. **Hence Statement 4 is correct.**

Q.44) With reference to uses of noble gases, consider the following pairs:

Noble gas	Use in
1. Neon	Discharge tubes
2. Argon	Welding industry
3. Xenon	Jet propellant

Which of the pairs given above are correctly matched?

a) 1 and 2 only
b) 2 and 3 only
c) 1 and 3 only
d) 1, 2 and 3

Q.44) Solution (d)

Explanation:

- Neon is used in discharge tubes. Neon bulbs are used in botanical gardens and in green houses. It is also used to make high-voltage indicators and switching gear, lightning arresters, diving equipment and lasers. **Hence Pair 1 is correct.**
- Argon is used mainly to provide an inert atmosphere in high temperature metallurgical processes (arc welding of metals or alloys) and for filling electric bulbs. It is used in the laboratory for handling substances that are air-sensitive. Argon is one of the elements used in the welding industry as it provides an inert atmosphere in which welded metals will not oxidise. **Hence Pair 2 is correct.**
- Xenon is used in many different ways, from high-intensity lamps to jet propellant. Xenon is the most common propellant used in ion propulsion. It is easily ionized and has a high atomic mass, thus generating a desirable level of thrust when ions are accelerated. It also is inert and has a high storage density; therefore, it is well suited for storing on spacecraft. **Hence Pair 3 is correct.**

Q.45) With reference to a subatomic particle called Neutrino, which of the following statements are correct?

1. It can be produced only through nuclear fission reactions.
2. It is an electrically neutral particle.
3. It can't be artificially produced.
4. It belongs to the category of leptons.

Select the correct answer using the code given below:

a) 1 and 2 only
b) 2 and 4 only
c) 1 and 3 only
d) 3 and 4 only

Q.45) Solution (b)

Explanation:

- Neutrinos can be produced in various situations. The Sun, and all other stars, produce neutrinos copiously due to nuclear fusion and decay processes within their core. There are many other natural sources of neutrinos including exploding stars (supernovae), relic neutrinos (from the birth of the universe), natural radioactivity, and cosmic ray interactions in the atmosphere of the Earth. **Hence Statement 1 is incorrect.**
- A neutrino is a fermion that interacts only via the weak interaction and gravity. The neutrino is so named because it is electrically neutral and because its rest mass is very small. **Hence Statement 2 is correct.**

- It can be artificially produced. Neutrinos can be produced by colliding a proton using a particle accelerator. **Hence Statement 3 is incorrect.**
- These belong to the category of leptons. Leptons are the particles that interact through the so-called weak force. For this reason and because it is electrically neutral, neutrino interactions with matter are extremely rare. Quarks interact with the strong nuclear force. Protons and neutrons belong to the category of quarks. **Hence Statement 4 is correct.**

Q.46) With reference to Pressurised Heavy Water Reactors (PHWRs) and Fast Breeder Reactors (FBRs), consider the following statements:

1. PHWRs use natural uranium as fuel whereas FBRs use thorium as fuel.
2. PHWRs use heavy water as coolant whereas FBRs use liquid sodium as coolant.

Which of the statements above is/are correct?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Q.46) Solution (b)

Explanation:

- The Pressurised Heavy Water Reactors (PHWRs) uses natural Uranium as fuel. PHWRs not only produce energy from natural uranium but also produce fissile plutonium (Pu)-239. The Fast Breeder Reactors (FBRs) use plutonium-239 (and not thorium) for generating electricity. **Hence Statement 1 is incorrect.**
- PHWR uses heavy water (deuterium oxide D2O) as its coolant and neutron moderator. FBRs do not have a neutron moderator, and use less-moderating coolants such as liquid sodium, so its neutrons remain high-energy. Breeder reactors use a small core, which is important to sustain chain reactions. **Hence Statement 2 is correct.**

Q.47) Consider the following elements:

1. Plutonium-239
2. Deuterium
3. Lithium Blanket

How many of the above elements can be used in generation of nuclear energy?

a) Only one
b) Only two

c) All three
d) None

Q.47) Solution (c)

Explanation:

- India has adopted a three-stage strategy of nuclear power generation. The first stage involves the use of natural uranium as a fuel, with heavy water as moderator. The Plutonium-239 obtained from reprocessing of the discharged fuel from the reactors then serves as a fuel for the second stage — the fast breeder reactors. The third stage, most significant in the long term, involves using fast breeder reactors to produce fissile Uranium-233 from Thorium-232 and to build power reactors based on them. **Hence option 1 is correct.**
- Deuterium, a heavier isotope of Hydrogen is one of the components of the fuel used in a nuclear fusion reactor. **Hence option 2 is correct.**
- A Lithium Blanket is a covering consisting of Lithium which is wrapped around the vacuum chamber containing the plasma in a nuclear fusion reactor (called a Tokamak). This covering slows the neutrons converting their kinetic energy into heat energy which is absorbed by the coolant (like water) to ultimately power turbines for production of power. **Hence option 3 is correct.**

Q.48) With respect to Bt-cotton, consider the following statements:

1. It is the first Genetically Modified (GM) crop approved for production in India.
2. The gene of a soil fungus known as Bacillus thuringiensis is used to produce Bt Cotton.
3. It has led to decrease in pesticide uses while simultaneously increasing the yield of cotton.

Which of the above statements is/are correct?

a) 1 only
b) 1 and 2 only
c) 1 and 3 only
d) 1, 2 and 3

Q.48) Solution (c)

Explanation:

- Bt cotton was the first GM crop approved in India in March 2002 for commercial cultivation. Bt. has been used as an insecticide to control stored grain pests in many other countries, including India, as sprays in cotton Integrated Pest Management (IPM) programs to control insects. **Hence, statement 1 is correct.**

- Bt cotton is a genetically modified (GM) cotton crop that expresses an insecticidal protein whose gene was derived from the soil bacterium (not fungus) Bacillus thuringiensis, also known as Bt. **Hence, statement 2 is not correct.**
- The use of Bt Cotton has led to reduction in the use of pesticides and it has reduced the risk of poisoning people who apply pesticides or work in the fields and animals. Bt cotton has also increased yields through better pest control and has benefited adopting farmers in India and several other developing countries. **Hence, statement 3 is correct.**

Q.49) With respect to Genetic Engineering Appraisal Committee (GEAC), consider the following statements:

1. GEAC is responsible for the appraisal of proposals relating to the release of genetically engineered organisms.
2. It gets its powers under Environment Protection Act 1986.
3. It functions under Ministry of Agriculture and Farmers' Welfare.

Which of the above statements is/are correct?

a) 1 and 2 only
b) 1 and 3 only
c) 2 and 3 only
d) 1, 2 and 3

Q.49) Solution (a)

Explanation:

- The Genetic Engineering Appraisal Committee (GEAC) is responsible for appraisal of activities involving large scale use of hazardous microorganisms and recombinants in research and industrial production from the environmental angle. It is also responsible for appraisal of proposals relating to release of genetically engineered (GE) organisms and products into the environment including experimental field trials. **Hence, statement 1 is correct.**
- GEAC is the statutory committee constituted under the "Rules for the Manufacture, Use/Import/Export and Storage of Hazardous Microorganisms/Genetically Engineered Organisms or Cells (Rules, 1989)" framed under Environment (Protection) Act, 1986. **Hence, statement 2 is correct.**
- The GEAC functions under the Ministry of Environment, Forest and Climate Change (MoEF&CC). It is chaired by the Special Secretary/Additional Secretary of MoEF&CC and co-chaired by a representative from the Department of Biotechnology (DBT). **Hence, statement 3 is not correct.**

Q.50) Which of the following are the likely benefits of using transgenic crops when compared to when compared to traditional crops?

1. Higher yield
2. Higher genetic diversity
3. Less requirement of pesticides
4. Sustainability in agriculture

Select the answer using the code given below:

a) 1 and 2 only
b) 1 and 3 only
c) 2 and 3 only
d) 2 and 4 only

Q. 50) Solution (b)

Explanation:

- The transgenic crops are engineered to have enhanced growth and development, which can lead to faster maturity, higher yields and higher levels of essential nutrients, such as vitamins and minerals. They also require less inputs such as weedicides, pesticides, insecticides, etc. However, they tend to decrease the genetic diversity within a species, as they involve selective breeding of a small number of individuals with desired traits. The production of transgenic crops also does not promote sustainability in agriculture. **Hence, option b is the correct answer.**

Q. 51) Other than resistance to pests, what are the prospects for which genetically engineered plants have been created?

1. To enable them to withstand drought.
2. To increase the nutritive value of the produce.
3. To enable them to grow and do photosynthesis in spaceships and space stations.
4. To increase their shelf life.

Select the correct answer using the codes given below:

a) 1 and 2 only
b) 3 and 4 only
c) 1, 2 and 4 only
d) 1, 2, 3 and 4

Q. 51) Solution (c)

Explanation:

Genetically modified (GM) is a technology that involves inserting DNA into the genome of an Organism. The cells are typically cultured in tissue culture after which they transform into plants. The modified DNA will be passed along to the seeds that these plants generate.
Future conflicts may be avoided with the introduction of genetically engineered (GE) drought-tolerant crops that can tolerate longer and more intense droughts. **Hence, Statement 1 is correct.**
Nutritional improved GM crops being developed include wheat variants free of gluten, a common trigger for food allergies, and vegetables with increased iron and vitamin A levels to avoid common nutritional deficits in developing countries. **Hence, Statement 2 is correct.**
Genetically Engineered plants have not been created to enable them to be grown in spacecraft, space stations, and submarines to perform photosynthesis. **Hence, Statement 3 is incorrect.**
Israel has created transgenic, longer-lasting banana plants. They can slow down plant ageing and give fruits like tomatoes an extra week of shelf life. **Hence, Statement 4 is correct.**

Q. 52) Bollgard I and Bollgard II technologies are mentioned in the context of

a) Clonal propagation of crop plants
b) Developing genetically modified crop plants
c) Production of plant growth substances
d) Production of biofertilizers

Q. 52) Solution (b)

Explanation:

Bollgard I (single-gene technology) is India's first biotech crop technology (Genetically modified crop) approved for commercialization in India in 2002, followed by Bollgard II – (double-gene technology) in mid-2006. Bollgard cotton has an insecticidal protein from a naturally occurring soil microorganism called Bacillus thuringiensis and offers built-in protection for cotton against destructive American Bollworm Heliothis Armigera infestations (Bt). The enhanced double-gene Cry1Ac and Cry2Ab technology found in Bollgard II technology protects against bollworms and Spodoptera caterpillars, improving boll retention, maximising yield, using fewer pesticides, and preventing insect resistance.
Hence, Option (b) is correct answer.

Q. 53) With reference to the recent developments in science, which one of the following statements is not correct?

a) Functional chromosomes can be created by joining segments of DNA taken from cells of different species.
b) Pieces of artificial functional DNA can be created in laboratories.
c) A piece of DNA taken out from an animal cell can be made to replicate outside a living cell in a laboratory.
d) Cells taken out from plants and animals can be made to undergo cell division in laboratory petri dishes.

Q. 53) Solution (a)

Explanation:

The combining of DNA fragments acquired from cells of different species cannot result in the creation of functional chromosomes. **Hence, Statement 1 is incorrect.**
In a lab, artificial functioning DNA fragments can be produced. Japanese researchers announced the creation of the first DNA molecule in the world that is almost entirely formed of synthetic components in 2007**. Hence Statement 2 is correct**
In a lab, it is possible to get a portion of animal DNA to reproduce on its own outside of a living cell. It is done through the Polymerase Chain Reaction (PCR) technology. **Hence Statement 3 is correct**
In a lab setting, Petri dishes can be used to induce cell division in isolated plant and animal cells. Plant cells are totipotent and a single cell has the capacity to divide through the process of mitosis in sterile conditions in a culture Petri dish to develop into a mature plant. **Hence Statement 4 is correct.**

Q. 54) Consider the following statement with respect to different application of biotechnology in environment:

1. Biomarkers can be used to measure the effect of pollution in the environment.
2. Biogas is the first-Generation biofuel.

Select the correct answer using codes given below:

a) 1 Only one
b) 2 Only two
c) Both 1 and 2
d) None of the above

Q. 54) Solution (c)

Explanation:

Biomarkers is an application of biotechnology in the environment that responds to the chemicals to measure the effect of pollution caused. A biomarker may change biological responses starting from the molecular level through cellular and physiological responses or by behavioural changes, which may be associated with exposure to a toxic effect of environmental chemicals**. Hence, Statement-1 is correct.**
Biofuels are usually applied in the industrial, domestic, and space sectors. In today's life, the need for Clean Energy has increased. There are three types of biofuels: First-generation biofuels, second generation biofuels, and third-generation biofuels. First-generation biofuels include bio alcohol (corn, sugarcane), biodiesel, syngas, and biogas. Examples of second-generation biofuels are cellulosic, biofuels, bio hydrogen, and bioethanol. Algae fuel comes under third generation biofuels. **Hence, Statement-2 is correct.**

Q.55) To meet its rapidly growing energy demand, w opine that India should pursue research and Development on thorium as the future fuel of energy. In this context, what advantage hold over uranium?

1. Thorium is far more abundant in nature uranium.
2. On the basis of per unit mass of mined mineral thorium can generate more energy compared natural uranium.
3. Thorium produces less harmful waste compared uranium.

Which of the statement(s) given above is/are correct?

a) Only 1
b) 2 and 3
c) 1 and 3
d) 1,2 and 3

Q.55) Solution: option (d)

Explanation:

. Thorium about four times more abundant than uranium. Thorin can also produce about 8 times more energy per unit ma as compared to uranium.
Thorium also produces much lesser radioactive element because of the nature of its fuel cycle. Thorium exclusively allows thermal breeder reactors as opposed faster breeder. It means that if the fuel is re-process reactor could be fuelled without making any additional U-235 for reactivity boasts which means the nuclear can be extended by 2 orders of the magnitude with complications of fast reactors. Thorium produces harmful waste compare to uranium.

Hence correct answer is option (d).

Q.56) Recently, India signed a deal known as 'Action Plan for Prioritisation and Implementation of Cooperation Areas in the Nuclear Field' with which of the following countries?

a) Japan
b) Russia
c) The United States of America
d) United Kingdom

Q. 56) Solution: option (b)

Explanation:

India signed a deal known as 'Action Plan for Prioritisation and Implementation of Cooperation Areas in the Nuclear Field' with Russia.
During the visit of HE Vladimir Putin, President of Russian Federation to India, 'Action Plan for Prioritisation and Implementation of Cooperation Areas in the Nuclear Field' identified jointly by India and Russia was signed on 5th October, 2018 in New Delhi.
For the New Nuclear Project in India, Russia will offer the evolutionary WWER or VVER (Water-Water Energetic Reactor) generation '3+' technical solutions.

Hence option (b) is the correct answer.

Q. 57) In India, why are some nuclear reactors kept under 'IAEA Safeguards' while others are riot?

a) Some use uranium and others use thorium.
b) Some use imported uranium and others use domestic supplies.
c) Some are operated by foreign enterprises and others are operated by domestic enterprises.
d) Some are state-owned and others are privately-owned.

Q. 57) Solution: option (b)

Explanation:

In India, some nuclear reactors are kept under 'IAEA safeguard' while others are riot because some use imported uranium and others uses domestic supplies.
A total of 26 nuclear reactors of India are under the safeguard of IAEA. The decision to put the reactors under the safeguard of IAEA is based on the source of uranium used in As Inthemot a signatory to the Nuclear Non-Proliferatise Treaty, the reactors that are under IAEA's safeguard use Imported uranium for civil peaceful purposes. The reactors India wants. for civil pe cosmetic uranium anywhere.
Hence option (b) is the correct answer.

Q.58) What is chain reaction in a nuclear power plant based on?

a) Particle bombardment
b) Fission
c) Subatomic fusion
d) Fusion

Q. 58) Solution: option (b)

Explanation:

Nuclear power plants are a type of power plant that uses the process of nuclear fission to generate electricity.
They use nuclear reactors in combination with the Rankine cycle, where the heat generated by the reactor converts water into steam, which spins a turbine and a generator.
The nuclear reactor is a key component of a nuclear power plant, as it contains the fuel and its nuclear fission chain reaction, along with all of the nuclear waste products.
A chain reaction refers to a process in which neutrons released in fission reaction produces an additional fission reaction in at least one further nucleus. This nucleus, in turn, produces neutrons, and the process repeats. The process may be controlled like in nuclear power or uncontrolled as in nuclear weapons.
Uranium is the dominant nuclear fuel used in nuclear reactors, and its fission reactions produce the heat within a reactor. This heat is then transferred to the reactor's coolant, which provides steam to the turbine of the nuclear power plant.
Hence Option (b) is the correct answer.

Q.59) Which of the following is NOT a commonly used fuel for nuclear power plants?

a) Pu - 236
b) U - 238
c) Pu - 244
d) U – 235

Q.59) Solution: option (c)

Explanation:

Pu - 236 is an isotope of plutonium
Uranium-238 is the most common isotope of uranium found in nature, with a relative abundance of 99%. Unlike uranium-235, it is non-fissile, which means it cannot sustain a chain reaction in a thermal-neutron reactor.
Plutonium-244 is the most stable isotope of plutonium
Plutonium has several industrial uses, particularly in the nuclear industry. Plutonium-239 is primarily used as a fuel to power nuclear reactors.

Hence Option (c) is the correct answer.

Q.60) Consider the following statements with reference to 'Nuclear Fusion':

1. Fusion means joining lighter nuclei to make a heavier nucleus.
2. Nuclear fusion reactions are the source of energy in the Sun and other stars.
3. Currently all commercial nuclear reactors are based on nuclear fusion.

Which of the given statement/s is/are correct?

a) 1 and 2 only
b) 1 and 3 only
c) 2 and 3 only
d) 1, 2 and 3

Q.60) Solution: option (a)

Explanation:

Statement 1	**Statement 2**
Correct	**Correct**
Fusion means joining lighter nuclei to make a heavier nucleus, most commonly hydrogen or hydrogen isotopes to create helium, such as $2H + 2H = 3He (+ n)$ It releases a tremendous amount of energy, according to the Einstein equation, as the mass of the product is little less than the sum of the masses of the original individual nuclei.	Such nuclear fusion reactions are the source of energy in the Sun and other stars. It takes considerable energy to force the nuclei to fuse. The conditions needed for this process are extreme – millions of degrees of temperature and millions of pascals of pressure. The hydrogen bomb is based on thermonuclear fusion reaction.
Statement 3	
Incorrect	
Currently all commercial nuclear reactors are based on nuclear fission. Fusion power is a proposed form of power generation that would generate electricity by using heat from nuclear fusion reactions	

Q.61) Consider the following statements:

1. Robots take permissible actions only.
2. All actions that are obligatory for robots are actually performed by them subject to ties and conflicts among available actions.

3. All permissible actions can be proved by the robot to be permissible and it can be explained in ordinary English.

Which of the above statements are correct?

a) 1 and 3 only
b) 1 and 2 only
c) 2 and 3 only
d) 1, 2 and 3

Q.61) Solution (b)

Explanation:

For a robot to be ethically correct, the robots take only permission action. All relative actions that are obligatory for robots are actually performed by them subjected to ties and conflicts among available action. All robot action cannot be explained by ordinary English. **Hence option (b) is correct**.

Q.62) In the context of digital technologies for entertainment, consider the following statements:

1. In Augmented Reality (AR), a simulated environment is created, and the physical world is completely shut out.
2. In Virtual Reality (VR), images generated from the computer are projected onto real-life objects or surroundings.
3. AR allows individuals to be present in the world and improve their experience using the camera of a smartphone or PC.
4. VR closes the world, and transposes an individual, providing a complete immersion experience.

Which of the statements given above is/are correct?

a) 1 and 2 only
b) 3 and 4 only
c) 1, 2 and 3 only
d) 4 only

Q.62) Solution: (b)

Explanation

Augmented reality (AR) is the superimposition of computer-generated images on existing environments to make them more interactive. It is utilized in the form of applications for mobile devices. **Hence Statements 1 and 2 are not correct.**

Virtual reality (VR) is a computer-generated simulation of real-life environments that is primarily achieved with the use of headsets. When worn, the user's vision and hearing are stimulated to provide realistic experiences.

VR completely puts the user in a simulated reality, AR blends the virtual and real. Like VR, an AR experience involves some sort of goggles through which we can view a physical reality whose elements are augmented (or supplemented) by computer-generated sensory input such as sound, video, graphics, or GPS data. **Hence Statements 3 and 4 are correct**

Q.63) Consider the following statements regarding the laws of robotics:

1. A robot may not injure a human being or through inaction, allow a human to be harmed.
2. A robot must obey orders given by humans except when that conflicts with the first law.
3. A robot must protect its own existence.

Which of the following statements are correct?

a) 1 and 2 only
b) 2 and 3 only
c) 1, 2 and 3
d) 1 and 3 only

Q.63) Solution: (a)

Explanation

The Three Laws of Robotics (often shortened to The Three Laws or known as Asimov's Laws) are a set of rules devised by science fiction author Isaac Asimov.
Asimov proposed three Laws of Robotics and later added the zeroth law
Law 0: A robot may not injure humanity or through inaction, allow humanity to come to harm
Law 1: A robot may not injure a human being or through inaction, allow a human being to come to harm unless this would violate higher-order law
Law 2: A robot must obey orders given to it by human beings, except where such orders would conflict with a higher-order law

Law 3: A robot must protect its own existence as long as such protection does not conflict with a higher-order law.
Hence Option (a) is correct.

Q.64) Which of the following is correct with respect to Robot motion.

a) Is not dependent on robot structure
b) Imitates human motion
c) Is same for all robots
d) None of the above

Q.64) Solution: (b)

Explanation

Robot: Different robots are made to perform different operations and for different operations, robots have different structures.
Robots with different structures are used to perform different tasks and hence have different motions.
Robots are used in industries to perform operations such as pulling, lifting, and inspections which are human motions and robots are designed to imitate them.
Hence Option (b) is correct answer.

Q.65) What does Bluebugging refers to:

a) It is a type of cyber-attack done on the Bluetooth enabled devices.
b) It is a type of soil degrading bacteria.
c) An asteroid capable of hitting the Earth
d) scientific phenomenon that occurs in the sea during the solar eclipse.

Q.65) Solution: (a)

Explanation

Bluebugging is a type of hacking technique in which an attacker gains unauthorized access to a device, such as a smartphone, by exploiting its Bluetooth connection.
Once the device is "blue bugged," the attacker can potentially listen to calls, read and send messages, steal and modify contacts, and even install malware on the compromised device.
Hence Option (a) is correct answer.

Q.66) The term "Bandicoot" is related to which of the following?

a) Child labour Alert system
b) Man-hole cleaning robot
c) Risk alert app for women
d) None

Q.66) Solution: (b)

Explanation

Bandicoot is a robotic system for manhole and sewer line cleaning aimed at the complete elimination of manual scavenging from the face of earth.
The Greater Hyderabad Municipal Corporation (GHMC) in 2019 procured a 'Bandicoot', which would help end the practice of manual scavenging.
Hence Option (b) is the correct answer.

Q.67) With reference to the 'Sophia- human-like robot', which of the following statements is/are correct?

1. She is the world's first robot citizen.
2. She is the first robot Innovation Ambassador for the UNDP.

Select the correct answer using the codes given below:

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Q.67) Solution: (c)

Explanation:

Hanson Robotics' most advanced human-like robot, Sophia, personifies our dreams for the future of AI.

- As a unique combination of science, engineering, and artistry, Sophia is simultaneously a human-crafted science fiction character depicting the future of AI and robotics, and a platform for advanced robotics and AI research.
- The character of Sophia captures the imagination of global audiences. She is the world's first robot citizen and the first robot Innovation Ambassador for the United Nations Development Programme.

Hence Option (c) is the correct answer.

Q.68) With reference to Global partnership on Artificial intelligent (GPAI), consider following statements:

1. It guides the responsible development and use of AI, grounded in human rights, inclusion, diversity, innovation and economic growth.
2. It is an international and multi-stakeholder initiative of which India is a founding member.
3. It will be supported by a secretariat, to be hosted by the organization for economic cooperation and development (OECD) in Paris.

Select the correct statement:

a) 1 and 2 only
b) 2 and 3 only
c) 1 and 3 only
d) All of the above

Q.68) Solution: (d)

Explanation:

Recently, India joins global partnership on Artificial Intelligence (GPAI) as a founding member to support the responsible and human-centric development and use of AI.

- It is an international and multi-stakeholder initiative including USA, UK, EU, Australia, Canada, France, Germany, Italy, Japan, Mexico, New Zealand, republic of Korea, Singapore.
- It guides the responsible development and use of AI, grounded in human rights, inclusion, diversity, innovation and economic growth.
- This is also a first initiative of its type for evolving better understanding of the challenges and opportunities around AI using the experience and diversity of participating countries.

It will be supported by a secretariat, to be hosted by organization for economic cooperation and development (OECD) in Paris, as well as by two centres of expertise one each in Montreal and Paris.
Hence all statements are correct.

Q.69) Which organization developed Indian robot named "Vyommitra"?

a) C-DAC, Pune
b) ISRO
c) TIFR
d) DRDO

Q.69) Solution: (b)

Explanation

- The word 'Vyommitra' is made up of two words of the Sanskrit language 'Vyom' and 'Mitra' which means space and friend respectively.
- This is the prototype of the half-humanoid female robot developed by ISRO.
- It was unveiled on 22 January 2020.

Hence Option (b) is correct answer.

Q.70) Consider the following statements:

1. Carbon fibres are used in the manufacture of components used in automobiles and aircrafts.
2. Carbon fibres, once used, cannot be recycled.

Which of the statements given above is/are correct?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Q.70) Solution: (a)

Explanation

Carbon fibre is a material consisting of very thin filaments of carbon atoms. Carbon Fibers are Fibers characterized by a carbon content of 90% or higher. The principal rationale behind the aerospace industry's adoption of carbon Fiber lies in the weight reduction it offers**. Hence**, **Statement 1 is correct**

Carbon fibre is environmentally friendly and exhibits a longer life cycle. There are numerous technologies to recycle carbon fibres. **Hence Statement 2 is not correct**

Q.71) Consider the following statements:

1. Other than those made by humans, nanoparticles do not exist in nature.
2. Nanoparticles of some metallic oxides are used in the manufacture of some cosmetics.
3. Nanoparticles of some commercial products which enter the environment are unsafe for humans.

Which of the above statements is/are correct?

a) 1 only
b) 3 only
c) 1 and 2 only
d) 2 and 3

Q.71) option (d) is correct answer

Explanation

Natural NPs are sourced from forest fires, volcanic eruptions, weathering, dust storms etc. E.g., iron oxides/sulphides, silver, and gold. **Hence Statement 1 is incorrect**

In order to provide an adequate level of sun protection, titanium dioxide and zinc oxide are frequently added to cosmetics among the metal and metal oxide nanoparticles (NPs) that may be present**. Hence Statement 2 is correct**

Workers including engineers, scientists, and technicians are mostly exposed at work while creating goods using nanomaterials, while on the other hand customers get exposed to such nanomaterials through usage and application, which may have hazardous and detrimental impacts. **Hence Statement 3 is correct**

Q.72) When reference to carbon nanotubes, consider the following statement:

1. They can be used as carriers of drugs and antigens in the human body.
2. They can be made into artificial blood capillaries for an injured part of the human body.
3. They can be used in biochemical sensors.
4. Carbon nanotubes are biodegradable.

Which of the statements given above are correct?

a) 1 and 2 only
b) 2, 3 and 4 only
c) 1, 3 and 4 only
d) 1, 2, 3 and 4

Q.72) Solution (c) is correct

Explanation

Carbon nanotubes have a high surface area, they go into the cell by the millions, and can have a very high efficiency of delivery to a specific cell. **Hence Statement 1 is correct.**

Carbon nanotubes cannot be made into artificial blood capillaries for an injured part of the human body as they are promising drug delivery platforms that can be functionalized with a variety of biomolecules, such as antibodies, proteins, or DNA. **Hence Statement 2 is incorrect.**

NASA has successfully demonstrated a miniaturized electronics technology with extremely high sensitivity and simplified sample preparation for in-vitro detecting specific biomarker signatures, which is based on incorporating embedded vertically aligned carbon nanotubes as nanoelectrode arrays in diagnostics devices**. Hence Statement 3 is correct.**
Multiple types of microbes, including bacteria and fungi, have the ability to degrade carbon nanotubes (CNTs**). Hence Statement 4 is correct**.

Q.73) With reference to the use of nanotechnology in the health sector, which of the following statements is/are correct?

1. Targeted drug delivery is made possible by nanotechnology.
2. Nanotechnology can largely contribute to gene therapy.

Select the correct answer using the codes given below:

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Q.73) Solution: option (c)

Explanation

- Nanotechnology deals with the understanding and controlling of matter at level of 1 and 100 nano-meters, where unique phenomena enable novel applications.
- Targeted drug distribution by nanoscale drug carriers is one of the fundamental tenets of nanomedicine. Numerous nanoscale drug delivery technologies, such as liposomes, dendrimers, quantum dots, nanotubes, polymeric biodegradable nanoparticles, and nano-capsules, have been studied.
- In addition to enabling new therapeutic classes and encouraging the re-investigation of previously unfeasible new molecular entities that are pharmaceutically suboptimal but biologically active, nanoscale delivery vehicles can improve the therapeutic efficacy and minimise side effects associated with existing medications.
- The development of medical nanotechnology can significantly advance genetic treatment. If diseases are handled from a genetic perspective, they are simple to treat. Therefore, using nanotechnology will enable medical professionals to treat illnesses by focusing on their fundamental causes rather than just their symptoms.

One of the key aspects of nanomedicine is targeted drug delivery by nanoscale drug carriers. **Hence Statement 1 is correct**.

Medical nanotechnology can largely contribute to genetic therapy and improvement. **Hence Statement 2 is correct**

Q.74) With reference to street - lighting, how do sodium lamps differ from LED lamps?

1. Sodium lamps produce light in 360 degrees but it is not so in the case of LED lamps.
2. As street -lights, sodium lamps have a longer lifespan than LED lamps.
3. The spectrum of visible light from sodium lamps is almost monochromatic while LED lamps offer significant colour advantages in street lighting.

Select the correct answer using the code given below:

a) 3 only
b) 2 only
c) 1 and 3 only
d) 1, 2 and 3

Q.74) Solution:(c)

Explanation

Sodium lamps emit light in all directions i.e., 360 degree. Because at least half of the light must be reflected and redirected to the intended area of illumination, this technique is significantly inefficient. LEDs, however, emit light in all 180 degrees. Since light is frequently needed over a target region, this is usually advantageous (rather than all 360 degrees around the bulb**). Hence Statement 1 is correct.**

High Pressure Sodium (HPS) lights or Sodium lamps have a typical lifespan for sodium lights or sodium lamps is in the range of 24,000 hours. At the halfway point of their lifespan, HPS lamps continue to provide 90% of their initial light output, according to American Electric Lighting. Lumen maintenance at the end of its useful life is still very good at 80%. LEDs have a longer lifespan than any other commercially available light source. **Hence Statement 2 is incorrect.**

Monochromatic light means that the light has a single wavelength, for e.g., sodium light. The LED light is not monochromatic because it is made up of different wavelengths, therefore is polychromatic**. Hence Statement 3 is correct.**

Q.75) With reference to new technological developments, which of the following statements is incorrect regarding Nanotechnology?

a) It is based on building or constructing materials and devices on the scale of atoms and molecules.
b) Its commercial usage is restricted due to lack of cost-effectiveness.

c) It has potential applications in various fields including health, sanitation, food security and environment protection.
d) All of the above statements given in (a), (b) and (c) are correct.

Q.75) Solution (b)

Explanation:

- Nanotechnology is a technology for building or constructing materials, devices, tools etc. in smallest or lowest possible form i.e. on the scale of atom and molecule. One nanometre is a one billionth of a meter. **Hence, statement a is correct.**
- Applications of this technology will help manufacturing products at reduced cost which will be smaller, lighter and cheaper. **Hence, statement b is incorrect.**
- The Nanotechnology is believed to be very promising in bringing solutions in the fields of health and sanitation, food security and environmental issues.
- Nanotechnological inventions would bring enormous benefits and luxury in human life. It is widely believed that nanotechnology has got the much needed potential to be effective in terms of energy consumption besides being environment friendly. It is also expected to solve major health problems. **Hence, statement c is correct.**

Q.76) The Nanotechnology can find applications in which of the following?

1. Water purification systems.
2. Removal of oil-spills from the oceans.
3. Reduce transmission power loss.

Select the correct answer using the codes given below:

a) 1 and 2 only
b) 1 and 3 only
c) 2 and 3 only
d) 1, 2 and 3

Q.76) Solution (d)

Explanation:

- Nanoscience and nanotechnology are the study and application of extremely small things and can be used across all the other science fields, such as chemistry, biology, physics, materials science, and engineering. Nanotechnology is science, engineering, and technology conducted at the nanoscale, which is about 1 to 100 nanometers.
- Carbon nanotubes (CNTs) have emerged as the foremost nanomaterial (NM) for water purification. It can remove almost all three types of pollutants, i.e. organic, inorganic and biological pollutants. This is because of their large surface area, high aspect ratio

and greater chemical reactivity along with lower cost and energy. **Hence Statement 1 is correct.**

- Using chemical reactions, nanoparticles are being developed to clean industrial water pollutants in groundwater. Researchers are also designing magnetic water repellent nanoparticles that can be used in oil spills to remove oil from the water by using magnets. **Hence Statement 2 is correct.**
- Researchers are developing wires containing carbon nanotubes that will have much lower resistance than the high-tension wires currently used in the electric grid, thus reducing transmission power loss. **Hence Statement 3 is correct.**

Q.77) Consider the following statements about Nano Mission in India:

1. It involves funding of basic research by individual scientists.
2. It involves facility development for technologies like Optical Tweezers, Atomic Microscope (AFM).

Which of the statements given above is/are not correct?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Q.77) Solution: (d)

Explanation

Nano India Mission

- The Government of India launched the Nano Mission in May 2007 as an "umbrella capacity-building program".
- It envisages the overall development of Nanotechnology in the country and taps some of its applied potential for a nation's development.
- The objectives of the Nano-Mission include:
- Basic Research Promotion: Funding of basic research by individual scientists and/or groups of scientists and the creation of centers of excellence for pursuing studies related to the Nanoscale.
- Infrastructure Development for Nano Science & Technology Research: It focuses on facility development for technologies like Optical Tweezers, Nano Indenter, Transmission Electron Microscope (TEM), Atomic Force Microscope (AFM), Scanning Tunneling Microscope (STM), Microarray Spotter & Scanner, etc.
- Nano Applications and Technology Development Programmes: The Mission proposes to promote application-oriented R&D Projects, establish Nano Applications and Technology Development Centers, Nano-Technology Business Incubators.
- Human Resource Development: The Mission focuses on providing effective education and training to researchers and professionals in diversified fields so that a genuine

interdisciplinary culture for nanoscale science, engineering and technology can emerge.

- International Collaborations: Apart from exploratory visits of scientists, organization of joint workshops and conferences and joint research projects, it focuses to facilitate access to sophisticated research facilities abroad, establish joint centers of excellence and forge academia-industry partnerships at the international level wherever required and desirable.

Hence correct answer is Option (d).

Q.78) Consider the following statements:

1. Other than those made by humans, nano particles do not exist in nature.
2. Nanoparticles of some metallic oxides are used in the manufacture of some cosmetics.
3. Nanoparticles of some commercial products which enter the environment are unsafe for humans.

Which of the statements given above is/are correct?

a) 1 only
b) 3 only
c) 1 and 2
d) 2 and 3

Q.78) Solution (d)

Explanation

Naturally occurring nanoparticles can be found in volcanic ash, ocean spray, fine sand and dust, and even biological matter (e.g. viruses). Synthetic nanoparticles are equally, if not more diverse than their naturally occurring counterparts. **Hence Statement 1 is incorrect**

The field of nanotechnology is being greatly explored by cosmetic industries in order to improve the efficacy of cosmetic products. The cosmetics are formulated by using different types of metal and metal oxide nanoparticles such as silver nanoparticles, gold nanoparticles (AuNPs) and titanium dioxide nanoparticles (TiO2 NPs), zinc oxide nanoparticles, iron oxide nanoparticles, (Fe2O3 NPs) and carbon-based NPs. The applications of different metal oxides as one of the active ingredients in cosmetics and sunscreens have attracted enormous interest from cosmetologists with advanced knowledge of chemistry, toxicology, dermatology, rheology, and even marketing. **Hence, Statement 2 is correct**

According to the National Nanotechnology Initiative thousands of tons of silica, alumina and ceria, in the form of ultrafine abrasive particle mixtures including nanoparticles, are used each year in slurries for precision polishing of silicon wafers. The exposed population to nano materials continues to increase as their application expands. Despite obvious benefits of the power of small materials, there are open questions about how the nanoparticles used for day-to-day life may affect the environment. One of the crucial issues that have to be addressed in

the near future, before massive fabrication of nano materials, is their toxicity to humans and impact on the environment**. Hence, Statement 3 is correct**

Q.79) Which of the following are the applications of Nanotechnology in food processing sector?

1. Enhanced Nutrient Delivery
2. Antimicrobial Packaging
3. Green Packaging

Select the correct answer using the code given below:

a) 1 and 2 only
b) 2 and 3 only
c) 1 and 3 only
d) 1, 2 and 3

Q.79) Solution: (d)

Explanation

Nanotechnology in Food Processing
Nanotechnology offers some exciting potential benefits for the quality and safety of our foods such as:

- Contamination Sensor: Flashlight to reveal the presence of E. coli bacteria.
- Antimicrobial Packaging: Edible food films made with cinnamon or oregano oil, or nanoparticles of zinc, calcium other materials that kill bacteria.
- Improved Food Storage: Nano-enhanced barrier keeps oxygen-sensitive foods fresher.
- Enhanced Nutrient Delivery: Nano-encapsulating improves the solubility of vitamins, antioxidants, healthy omega oils and other 'nutraceuticals'.
- Green Packaging: Nano-fibers made from lobster shells or organic corn are both antimicrobial and biodegradable.
- Pesticide Reduction: A cloth saturated with nanofibers slowly releases pesticides, eliminating the need for additional spraying and reducing chemical leakage into the water supply.
- Tracking, Tracing Brand Protection: Nanobarcodes can be created to tag individual products and trace outbreaks.
- Texture: Food spreadability and stability improve with nano-sized crystals and lipids for better low-fat foods.
- Flavour: Trick the tongue with bitter blockers or sweet and salty enhancers.
- Bacteria Identification and Elimination: Nano carbohydrate particles bind with bacteria so they can be detected and eliminated.

Hence correct answer is Option (d).

Q.80) Consider the following statements with reference to Nanotechnology:

1. It involves science and engineering of objects in the range of only 1 to 10 nano-meter.
2. An atomic force microscope is used to generate images of nano-scale details on a physical surface.

Which of the statements given above is/are correct?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Q.80) Solution: (b)

Explanation

Nanotechnology

- The idea of nanotechnology was born in 1959 when physicist Richard Feynman gave a lecture exploring the idea of building things at the atomic and molecular scale.
- The term 'Nanotechnology' was coined in 1974 by Norio Taniguchi of Tokyo Science University to describe semiconductor processes such as thin-film deposition that deal with control on the order of nanometers.
- Nanotechnology is science, engineering, and technology conducted at the nanoscale, which is about 1 to 100 nanometers.
- Nanoscience and nanotechnology are the study and application of extremely small things and can be used across all the other science fields, such as chemistry, biology, physics, materials science, and engineering.
- An Atomic force microscope is a scientific instrument that can generate images of nanoscale details on a physical surface by scanning small nanoscale probes.

Hence correct answer is Option (b).

Q.91) In which of the following areas, quantum technologies can be used?

1. Secure communication
2. Disaster management
3. Healthcare
4. Cryptography

Select the answer using code given below:

a) 1 and 2 only
b) 2 and 3 only
c) 1, 2 and 3 only

d) 1, 2, 3 and 4

Q.91) Solution (d)

Explanation:

- Quantum Technology is based on the principles of Quantum mechanics developed in the early 20th century to describe nature at the scale of atoms and elementary particles. It finds its application in various areas such as secure communication, disaster management through better prediction, computing, simulation, chemistry, healthcare, cryptography, etc. **Hence, option d is the correct answer.**

Q.92) With respect to Li-Fi technology, consider the following statements:

1. It is a bidirectional wireless system that uses visible light for communication.
2. It transmits data with the help of Light Emitting Diode (LED).

Which of the above statements is/are correct?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Q.92) Solution (c)

Explanation:

- Li-Fi (Light Fidelity) Technology is a bidirectional wireless system that uses visible light (400-800 Terahertz) for communication. It was first unveiled in 2011 and, unlike wifi, which uses radio frequency, LiFi technology only needs a light source with a chip to transmit an internet signal through light waves. **Hence, statement 1 is correct.**
- It transmits data with the help of Light Emitting Diode (LED). The On/off activity of the LED transmitter enables data transmission in accordance with the incoming binary codes. **Hence, statement 2 is correct.**

Q.93) With respect to National Quantum Mission, consider the following statements:

1. The National Quantum Mission is implemented by Ministry of Science & Technology.
2. India is only the fourth country to have a dedicated quantum mission after the USA, Russia and China.

Which of the above statements is/are correct?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Q.93) Solution (a)

Explanation:

- The National Quantum Mission, planned for 2023-2031 aims to seed, nurture, and scale up scientific and industrial R&D and create a vibrant & innovative ecosystem in Quantum Technology (QT). It is implemented by the Department of Science & Technology (DST) under the Ministry of Science & Technology. **Hence, statement 1 is correct.**
- India is the seventh country to have a dedicated quantum mission after the US, Austria, Finland, France, Canada and China. It will target developing intermediate scale quantum computers with 50-100 physical qubits in 5 years and 50-1000 physical qubits in 8 years. **Hence, statement 2 is not correct.**

Q.94) Consider the following statements:

1. Intellectual Property Rights are outlined in the Universal Declaration of Human Rights.
2. The importance of intellectual property was first recognized in the Budapest treaty.

Which of the above statements is/are INCORRECT?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Q.94) Solution (b)

Explanation:

- Intellectual Property Rights are outlined in Article 27 of the Universal Declaration of Human Rights, which provides for the right to benefit from the protection of moral and material interests resulting from authorship of scientific, literary or artistic productions. **Hence, statement 1 is correct.**
- The importance of intellectual property was first recognized in the Paris Convention for the Protection of Industrial Property (1883) and the Berne Convention for the Protection of Literary and Artistic Works (1886). Both treaties are administered by the World Intellectual Property Organization (WIPO). The Budapest Treaty on the

International Recognition of the Deposit of Microorganisms for the Purposes of Patent Procedure was signed much later in 1977. **Hence, statement 2 is INCORRECT.**

Q.95) Consider the following statements:

1. The National Intellectual Property Rights (IPR) Policy was adopted in 1991 in India.
2. Department of Industrial Policy & Promotion (DIPP) acts as the nodal department to oversee the implementation of IPRs in India.
3. India's IPR regime is in compliance with the WTO's agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS).

Which of the above statements are correct?

a) 1 and 2 only
b) 1 and 3 only
c) 2 and 3 only
d) 1, 2 and 3

Q.95) Solution (c)

Explanation:

- The National Intellectual Property Rights (IPR) Policy 2016 was adopted in May 2016 as a vision document to guide future development of IPRs in the country. It encompasses and brings to a single platform all IPRs, taking into account all inter-linkages and thus aims to create and exploit synergies between all forms of intellectual property (IP), concerned statutes and agencies. **Hence, statement 1 is not correct.**
- Department of Industrial Policy & Promotion (DIPP), Ministry of Commerce, Government of India, has been appointed as the nodal department to coordinate, guide and oversee the implementation and future development of IPRs in India. The 'Cell for IPR Promotion & Management (CIPAM)', setup under the aegis of DIPP, is to be the single point of reference for implementation of the objectives of the National IPR Policy. **Hence, statement 2 is correct.**
- India is a member of the World Trade Organisation and committed to the Agreement on Trade Related Aspects of Intellectual Property (TRIPS Agreement). And India's IPR regime is in compliance with the WTO's agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS). **Hence, statement 3 is correct.**

Q.96) Consider the following description:

1. It is a secret network.
2. It consists of a series of websites hidden from the general public.
3. It is not accessible through traditional search engines such as google.

The above features best describe which of the following?

a) Cloud computing
b) White web
c) World web
d) Dark web

Q.96) Solution (d)

Explanation:

- The dark web refers to encrypted online content and allows individuals to hide their identity and location from others. Dark web content is not indexed by conventional search engines. To access the dark web, users must install a private browser, like the TOR Browser, use a Virtual Private Network (VPN), and ensure their computer remains safe and secure. **Hence, option d is the correct answer.**

Q.97) With respect to 5G technology, consider the following statements:

1. The 'G' in 5G stands for 'generation.'
2. The peak rate of 5G is up to 100 Gbps.
3. It is completely immune from cyberthreats and hacking.

Which of the above statements are correct?

a) 1 only
b) 1 and 2 only
c) 1 and 3 only
d) 1, 2 and 3

Q.97) Solution (a)

Explanation:

- The 'G' in 5G stands for 'generation.' 5G is the fifth and newest generation of cellular network technology and it allows more devices to use the network than ever before. **Hence, statement 1 is correct.**
- The speed of 4G is up to 100Mbps, while the speed of 5G is up to 10Gbps (not 100 Gbps). The biggest difference between 4G and 5G is latency. 5G can offer low latency under 5 milliseconds, while 4G latency ranges from 60 ms to 98 ms. Lower latency brings advancements in other areas, such as faster download speeds. **Hence, statement 2 is not correct.**

- 5G networks, like any new technology is vulnerable to security threats such as hacking and cyberattacks. Further, concerns about personal privacy may also arise as a result of the increased use of data and connected devices enabled by 5G technology. **Hence, statement 3 is not correct.**

Q.98) With reference to Visible Light Communication (VLC) technology, which of the following statements are correct?

1. VLC uses electromagnetic spectrum wavelengths 375 to 780 nm.
2. VLC is known as long - range optical wireless communication.
3. VLC can transmit large amounts of data faster than Bluetooth.
4. VLC has no electromagnetic interference.

Select the correct answer using the code given below:

a) 1, 2 and 3 only
b) 1, 2 and 4 only
c) 1, 3 and 4 only
d) 2, 3 and 4 only

Q.98) Solution(b)

Explanation:

Visible light communication (VLC) is a data communications variant which uses visible light between 400 and 800 THz (375–780 nm). VLC is a subset of optical wireless communications technologies**. Hence Statement 1 is correct.**
The light can transmit information either directly or reflected from a surface. It can do so while dimmed. However, light cannot penetrate obstacles such as walls. Thus, for wireless communication purposes VLC cannot be used for long distances. **Hence Statement 2 is incorrect.**
Bluetooth transmits data at the rate of 300kbps (kilobytes per second), while VLC can transmit data in the range between mbps -gbps (megabytes per second to gigabytes per second). **Hence Statement 3 is correct.**
VLC has the characteristic to resist electromagnetic interference. So, it does not cause Electromagnetic interference. **Hence Statement 4 is correct.**

Q.99) With reference to "Blockchain Technology" consider the following statements:

1. It is a public ledger that everyone we inspect, but which no single user controls.
2. The structure and design of blockchain is such that all the data in it is about crypto currency only.
3. Applications that depend on basic features of blockchain can be developed without anybody's permission.

Which of the statements given above is/are correct?

a) 1 only
b) 1 and 2 only
c) 2 only
d) 1 and 3 only

Q.99) Solution(d)

Explanation

A blockchain is a decentralised, distributed, and oftentimes public, digital ledger consisting of records called blocks that is used to record transactions across many computers so that any involved block cannot be altered retroactively, without the alteration of all subsequent blocks. **Hence Statement 1 is correct.**
Blockchain technology can be used in property exchanges, bank transactions, healthcare, smart contracts, supply chain, and even in voting for a candidate. **Hence Statement 2 is incorrect**
The great advantage to an open, permissionless, or public, blockchain network is that guarding against bad actors is not required and no access control is needed**. Hence Statement 3 is correct**

Q.100) With reference to communications technologies, what is/ are the difference/differences between LTE (Long-Term Evolution) and VoLTE (Voice over Long-Term Evolution)?

1. LTE is commonly marketed as 3G and VoLTE is commonly marketed as advanced 3G.
2. LTE is data-only technology and VoLTE is voice-only technology.

Select the correct answer using the code given below:

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Q.100) Solution(d)

Explanation

Long term Evolution (LTE) is commonly marketed as 4G LTE. **Hence Statement 1 is incorrect**

VoLTE is an Internet Protocol Multimedia Subsystem (IMS) specification which enables a variety of services to operate seamlessly on the network rather than having to switch to different applications for voice or video. **Hence Statement 2 is incorrect**

Q.101) With reference to 'LiFi', recently in the news, which of the following statements is/are correct?

1. It uses light as the medium for high-speed data transmission.
2. It is a wireless technology and is several times faster than 'WiFi'.

Select the correct answer using the code given below:

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Q.101) Solution (c)

Explanation

LiFi is a Visible Light Communications system transmitting wireless internet communications at very high speeds. **Hence Statement 1 is correct.**
LiFi transmission speeds can go over 100 Gbps, 14 times faster than WiGig, also known as the world's fastest WiFi. **Hence Statement 2 is correct**.

Q.102) With reference to 'Near Field Communication (NFC) Technology', which of the following statements is/are correct?

1. It is a contactless communication technology that uses electromagnetic radio fields.
2. NFC is designed for use by devices which can be at a distance of even a metre from each other.
3. NFC can use encryption when sending sensitive information.

Select the correct answer using the codes given below:

a) 1 and 2 only
b) 3 only
c) 1 and 3 only
d) 1, 2 and 3

Q.102) Solution (c)

Explanation

NFC technology is perfectly designed to exchange data between two devices through a simple touch gesture. **Hence Statement 1 is correct.**
NFC technology is designed for an operation distance of a few Centimetre, this makes it more difficult for attackers to record the communication between an NFC Forum Device and an NFC Forum Tag compared to other wireless technologies which have a working distance of several meters. **Hence Statement 2 is incorrect**.
The security level of the NFC communication is by default higher compared to other wireless communication protocols. **Hence Statement 3 is correct.**

Q.103) In addition to fingerprint scanning, which of the following can be used in the biometric identification of a person?

1. Iris scanning.
2. Retinal scanning.
3. Voice recognition.

Select the correct answer using the code given below;

a) 1 only
b) 2 and 3 only
c) 1 and 3 only
d) 1, 2 and 3

Q.103) Solution:(d)

Explanation:

- In computer science Biometrics identification is used as a form of identification and access control. Biometric identifiers are the distinct, measurable characteristics used to label individuals.
- Behavioural Indicators: Physiological characteristics are distinguished from behavioural traits when classifying biometric identifiers. Fingerprint, palm veins, face recognition, DNA, palm print, hand geometry, iris recognition, retina, and odour/scent are examples of physiological biometric identifiers. Gait, voice, and typing rhythm are behavioural indicators.
- Iris scanning: It is a form of biometric technology which uses visible and near-infrared light to take a high-contrast photograph of a person's iris. **Hence Statement 1 is correct.**

- Retinal scanning: It maps the unique patterns of a person's retina. The blood vessels within the retina absorb light more readily than the surrounding tissue and thus easily identify with appropriate lighting. It is highly accurate and difficult to spoof, in terms of identification. **Hence Statement 2 is correct.**
- Voice recognition: It is a computer software program which can decode the human voice. It is used to operate a device or perform commands**. Hence Statement 3 is correct.**

Q.104) What is the difference between Bluetooth and Wi-Fi devices?

a) Bluetooth uses 2.4 GHz radio frequency band, whereas Wi-Fi can use 2.4 GHz or 5 GHz frequency band.
b) Bluetooth is used for Wireless Local Area Networks (WLAN) only, whereas Wi-Fi is used for Wireless Wide Area Networks (WWAN) only.
c) When information is transmitted between two devices using Bluetooth technology, the devices have to be in the line of sight of each other, but when Wi-Fi technology is used the devices need not be in the line of sight of each other.
d) The statements (a) and (b) given above are correct in this context.

Q.104) Solution (a)

Explanation:

Bluetooth	**WiFi**
It is a wireless technology that is used for exchanging data between mobile devices over short distance using radio waves.	It is a wireless networking technology that uses radio waves to provide wireless high-speed internet and network connections.
Requires Bluetooth adaptors.	Requires wireless adaptor and router.
Frequency 2.4 Ghz	Frequency 2.4 – 5 Ghz
Consumes low power.	Consumes high power.
Are less secure.	Are more secure.
No need for devices to be in line of sight; they just need to be with in Bluetooth's range.	No need for devices to be in line of sight; they just need to be with in range of WiFi.
Coverage 10 meters.	Coverage 32 meters.
Needs low bandwidth.	Needs high bandwidth.

Q.105) What is a "Virtual Private Network"?

a) It is a private compute network of an organization where he remote users can transmit encrypted information through the server of the organization.

b) It is a computer network across a public internet that provides users access to their organization's network while maintaining the security of the information transmitted.
c) It is a computer network in which users can access a shared pool of computing resources through a service provider.
d) None of the statements (a), (b) and (c) given above is a correct description of Virtual Private Network.

Q.105) Solution: option (b)

Explanation:

- VPN: An encrypted connection between a device and a network via the Internet is known as a virtual private network, or VPN. Secure transmission of sensitive data is aided by the encrypted connection. It makes it impossible for unauthorised parties to eavesdrop on the traffic and enables remote work for the user.
- By creating secure connections over the Internet, a VPN expands a company network. Traffic stays private while travelling because it is encrypted between the device and the network. Even smartphones and tablets can connect through a VPN. Hence correct answer is option (b).

Q.106) Which of the following services does not come under category of cloud computing?

a) IaaS (infrastructure as a services)
b) SaaS (software as a services)
c) PaaS (Platform as a services)
d) BdaaS (Big data as a services)

Q.106) Solution: Option (d)

Explanation

Cloud Computing is primarily broadly categorized as:
1. Infrastructure-as-a-Service.
2. Platform-as-a-Service.
3. Software-as-a-Service.

Infrastructure as a service (IaaS) is a type of cloud computing service that offers essential compute, storage and networking resources on demand, on a pay-as-you-go basis.

Software as a service (SaaS) is a software distribution model in which a cloud provider hosts applications and makes them available to end users over the internet.

Cloud platform services, also known as Platform as a Service (PaaS), provide cloud components to certain software while being used mainly for applications.

Big data as a service (BDaaS) is the delivery of data platforms and tools by a cloud provider to help organizations process. **Hence correct answer is option D.**

Q.107) Consider the following statement:

1. Crypto-currency mining uses huge amount of energy and emit pollutants.
2. 'Proof of work' is a consenus mechanism that allows miners to validate crypto-currency transactions.

Which of the statements given above is/are correct?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Q.107) Solution: option (c)

Explanation:

Cambridge Bitcoin Electricity Consumption Index, by the Centre for Alternative Finance at the University of Cambridge. shows that Bitcoin mining alone used up more energy than Belgium and Finland (bit.ly/3cpu86E). According to Digiconomist, Ethereum gobbled up as much power as Switzerland. The Bitcoin network generates huge amounts of carbon dioxide, as much as Turkmenistan, and Ethereum's CO2 emissions rival New Zealand's. As if this was not enough, the obsolete ASIC (Application Specific Integrated Circuit) mining equipment that crypto miners use produces a colossal 36,000 tonnes of electronic waste every year. **Hence Statement 1 is correct**.
'Proof of work' is a consensus mechanism that allows miners to validate cryptocurrency transactions by deciphering increasingly complicated mathematical puzzles. Whoever solves a puzzle validates that transaction and gets the mined crypto; solving these arcane problems requires heavy computing power and therefore uses tremendous energy. **Hence Statement 2 is correct.**

Q.108) With reference to 'near field communication (NFC) technology, which of the following statements is/are correct?

1. It is a contactless communication technology that uses electromagnetic radio fields.
2. NFC is designed for use by devices which can be at a distance of even a meter from each other.
3. NFC can use encryption when sending sensitive information.

Select the correct answer using the code given below:

a) 1 and 2 only
b) 3 only
c) 1 and 3 only
d) 1, 2 and 3

Q.108) Solution: option (c)

Explanation:

Near Field Communication (NFC)
It is a contactless communication technology based on an electromagnetic radio frequency (RF). **Hence, Statement 1 is correct.**
It uses a base frequency of 13.56 MHz.
It is perfectly designed to exchange data between two devices through a simple touch gesture.
It is designed for an operating distance of a few centimetres. **Hence, Statement 2 is incorrect.**
This makes it more difficult for attackers to record the communication as compared to other wireless technologies which have a working distance of several meters.
It can use encryption when sending sensitive information. **Hence, Statement 3 is correct.**

Q.109) Consider the following statement regarding "national automated fingerprint identification system (NAFIS)":

1. It is a pan-India searchable database of crime and criminal-related fingerprints.
2. It is developed by the national crime records bureau (NCRB).

Which of the statements given above is/are correct?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Q.119) Solution: option (c)

Explanation:

India has inaugurated a National Automated Fingerprint Identification System (NAFIS): A pan-India searchable database of crime and criminal-related fingerprints.
NAFIS is developed by the National Crime Records Bureau (NCRB**). Hence Option (c) is correct answer.**

Q.110) with reference to web 5.0, consider the following statements;

1. It is aimed to build an extra decentralized web that puts one in control of their data and identity.
2. It is a combination of web 1.0 and web 2.0.

Which of the statement given above is/are correct?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Q.110) Solution: option (a)

Explanation:

It is aimed to build an extra decentralized web that puts one in control of their data and identity. **Hence Statement 1 is correct.**
web 5.0 is web 2.0 plus web 3.0 that will allow users to 'own their identity on the internet and control their data'. **Hence Statement 2 is incorrect**