ANSWERS & EXPLANATIONS
GENERAL STUDIES (P) TEST – 4719 (2025)

Q 1.A

- The Sun provides the energy that drives Earth's climate, but not all of the energy that reaches the top of the atmosphere finds its way to the surface. That's because aerosols—and clouds seeded by them—reflect about a quarter of the Sun's energy back to space.
- Although most aerosols reflect sunlight, some also absorb it. An aerosol's effect on light depends primarily on the composition and color of the particles. Broadly speaking, bright-colored or translucent particles tend to reflect radiation in all directions and back towards space. Darker aerosols can absorb significant amounts of light.
- **Pure sulfates and nitrates** reflect nearly all radiation they encounter, cooling the atmosphere.
- **Salt particles** tend to reflect all the sunlight they encounter, thus helps in cooling the earth.
- Aerosols can have a major impact on climate when they scatter light. In 1991, the eruption of Mount Pinatubo in the Philippines ejected more than 20 million tons of sulfur dioxide—a gas that reacts with other substances to produce **sulfate aerosol**—as high as 60 kilometers (37 miles) above the surface, creating particles in the stratosphere. Those bright particles remained above the clouds and didn't get washed from the sky by rain; they settled only after several years.
- Climatologists predicted global temperatures would drop as a result of that global sulfate infusion.
- On the other hand all the green house gases (water vapour, carbon dioxide, methane, nitrous oxide, fluorinated gases), warms the earth's atmosphere.

Q 2.A

- **Bioremediation** is the use of microbial species to clean up soil and groundwater that has been contaminated by discharged chemicals. Bioremediation stimulates the growth of specific microbes that use the discharged chemical contaminants as a source of food and energy.
- The microorganisms may be indigenous to a contaminated area or they may be isolated from elsewhere and brought to the contaminated site.
- The process of bioremediation can be monitored indirectly by measuring the Oxidation Reduction Potential or redox in the soil and groundwater, together with pH, temperature, oxygen content, electron acceptor/ donor concentration, and concentration of breakdown products (eg carbon dioxide)
- **Bioremediation strategies**
  - In situ bioremediation techniques
  - Ex-situ bioremediation techniques
- **Insitu remediation techniques**
- It involves the treatment of the contaminated material at the site.
- **Bioventing:** In this, the supply of air and nutrients through wells to contaminated soil to stimulate the growth of indigenous bacteria. It is used for hydrocarbons and can be used where the contamination is deep under the surface.
- **Biosparging:** Injection of air under pressure below the water table to increase groundwater oxygen concentrations and enhance the rate of biological degradation of contaminants by naturally occurring bacteria.

- **Bioaugmentation:** Micro-organism are imported to a contaminated site to enhance the degradation process.
- **Exsitu bioremediation techniques**
- It involves the removal of the contaminant materials to be treated elsewhere.
- **Landfarming:** It is an ex-situ waste treatment process that is performed in the upper soil zone or in biotreatment cells. Contaminated soils, sediments, or sludges are transported to the land farming site, incorporated into the soil surface and periodically turned over (tilled) to aerate the mixture. In this environment, the micro-organisms present in the soil are more able to break down the contaminants in the soil.
- **Biopiles**: It is a process where piles of soil are placed over the top of a bug vacuum pump. The vacuum pump pulls air through the pile of soil to allow oxygen to get thought the sol to the mico-organisms. Contaminants that may be turned into gas forms are easily controlled as they are simply sucked with the air stream through the soil.
- **Composting:** It is a treatment where the waste is mixed in with straw, hay or corn cobs to maximize the water levels and air levels which the micro-organisms have access to. Composting can be done three ways:1. Static Pile - where a pile of compost is aerated using vaccums or blowers.2. Mechanically Agitated in-vessel composting - where the compost is put into a treatment tank where it is turned around and mixed so it can be aerated.3. Windrow Composting - where the compost is laid out in long piles where it can be mixed by a tractor
- **Bioreactors:** It involves the processing of contaminated solid material(soil, sediment, sludge) or water through an engineered containment system.

Q 3.D

- E-waste denotes waste electrical and electronic equipment, whole or in part or rejects from their manufacturing and repair process which are intended to be discarded and broadly comprises of discarded computer monitors, motherboards, mobile phones and chargers, compact discs, headphones, Cathode Ray Tubes (CRT), Printed Circuit Boards (PCB), televisions and so on.
- **Electronics are full of valuable materials, including copper, tin, iron, aluminum, fossil fuels, titanium, gold, and silver. Many of the materials used in making these electronic devices can be recovered, reused, and recycled—including plastics, metals, and glass.** Recycling e-waste enables us to recover various valuable metals and other materials from electronics, saving natural resources (energy), reducing pollution, conserving landfill space, and creating jobs. According to the EPA, recycling one million laptops can save the energy equivalent of electricity that can run 3,657 U.S. households for a year. **Recycling one million cell phones can also recover 75 pounds of gold, 772 pounds of silver, 35,274 pounds of copper, and 33 pounds of palladium. In a report, Apple revealed that it recovered 2,204 pounds of gold —worth $40 million—from recycled iPhones, Macs, and iPads in 2015.**
- E-waste also contains plastic, up to nearly 25 per cent of its weight. Novel recovery and conversion of e-waste plastics to value-added products have also been successfully developed. **The MeitY has developed affordable technologies to recycle valuable materials and plastics in an environmentally sound manner, including two exclusive PCB recycling technologies**, viz 1000 kg/ day capacity (~35 MT e-waste) and 100kg/batch (~3.5MT e-waste) processes, with acceptable environmental norms.

Q 4.D

- **Pollen preserves** best if the sedimentary environment lacks oxygen or is acidic, conditions unfavorable for the organisms that decompose pollen. Fossil pollen is an important kind of data for reconstructing past vegetation. Because vegetation is sensitive to climate, fossil pollen is a very important kind of proxy data for reconstructing past climates.
- Dendroclimatology is the science of determining past climates from trees (**primarily properties of the annual tree rings).**
- **Caves** are underground chambers contain the secrets of Earth's climate in what you may know as stalactites, stalagmites, and other formations. Collectively, scientists call the icicle-shaped rocks hanging

from the ceiling and the rock mounds that rise up out of a cave's floor "speleothems." And, it is how these speleothems form that allows them to hold a natural record of climate.

- **Lacustrine deposits** are sedimentary rock formations which formed in the bottom of ancient lakes. A common characteristic of lacustrine deposits is that a river or stream channel has carried sediment into the basin.
- **Hence the correct answer is option (d).**

Q 5.A

- Radioactive materials are those materials or elements that emit radiation, thus they are not stable and get transformed into other radioactive or non-radioactive materials. **The harm that they can cause depends on the radioactive elements and their half time function (the time needed for their concentration to be reduced to half due to radioactive decay processes). Basically, the higher the half-time, the lower the effects on human health.** Radioactive elements with a short and very short half-time pose a serious threat to human health because of their hazardous effects. Most of the radioactive materials have half-lives of hundreds of thousands of years and, once generated, may persist in the environment for a very long time.
- **Cosmic Rays come from outer space to our planet with intense radiation as their nature, therefore, causing radioactive pollution.** Gamma rays, for example, are said to have the highest level of radiation and yet, depending on their intensity, some are not visible to the human eye. The quantity with which the rays hit the earth depends on the altitude of the earth and the geographical location.
- Radio isotopes are used to make detectors and in other industrial activities. Isotopes such as uranium have high concentrations of radiation in them. On the other hand, common Isotopes such as carbon-containing radioactive material are easily found in waterways through sewage lines. **Examples of radioactive isotopes includes Chromium-51, Cobalt-57 & 60, Calcium-47, Iodine-123, Krypton-85, Nickel-63 etc.**

Q 6.A

- **When wood is processed into paper, it produces a high-energy, toxic substance called black liquor. Until the 1930s, black liquor from paper mills was considered a waste product and dumped into nearby water sources.**
- However, black liquor retains more than 50% of the wood's biomass energy. With the invention of the recovery boiler in the 1930s, black liquor could be recycled and used to power the mill. In the U.S., paper mills use nearly all their black liquor to run their mills, and the forest industry is one of the most energy-efficient in the nation as a result.
- More recently, Sweden has experimented in gasifying black liquor to produce syngas, which can then be used to generate electricity.

Q 7.C

- **Extended producer responsibility, a practice and a policy approach in which producers take responsibility for management of the disposal of products they produce once those products are designated as no longer useful by consumers**. Responsibility for disposal may be fiscal, physical, or a combination of the two.
- Motivations for extended producer responsibility practices include a mixture of economic, environmental, and social factors. **Extended producer responsibility shifts the economic burden of the cost of disposal from the government to the producer of the product.** Within an environmental context, products must be designed for recyclability, and extended producer responsibility encourages design for recycling while discouraging the use of toxic components in the product. Finally, extended producer responsibility meets increasing consumer demand for environmentally friendly products that can easily be recycled or are manufactured using recycled content. Extended producer responsibility is a product-focused strategy that encourages environmentally friendly design and disposal of products through transfer of this responsibility to product producers.

- The intergovernmental Organisation for Economic Co-operation and Development's (OECD) definition of extended producer responsibility identifies two specific features: the shifting of responsibility for disposal "upstream" from municipalities to producers and encouragement through incentives to make the design of products more environmentally friendly.

Q 8.D

- Dioxin and furan are chlorinated aromatic compounds having tremendous toxic effects, carcinogenicity and persistence in the environment; hence these Persistent Organic Pollutants (POPs) are real threats to the environment and existence of mankind.
- These compounds do not occur naturally, nor they are produced intentionally. In fact these are the byproducts of industrial and pollution control related operations, barring few catastrophic or accidental origins like volcanoes, **forest fires** and accidental fires etc.
- Sources:
  - **Municipal Solid Waste Incinerator**,
  - Open burning of domestic waste,
  - Bio-Medical waste incinerators and hazardous waste incinerators,
  - Industrial boilers and furnaces,
  - Petroleum refining,
  - Biogas combustion and landfill gas combustion,
  - **Candles, Crematoriums, Cigarette smoking,**
  - PVC manufacturing,
  - **Dyes and pigments,**
  - **Motor vehicle fuel combustion (Diesel and gasoline), Coal combustion for industrial, residential and commercial purposes.**
- **Hence all the options are correct.**

Q 9.B

- **Pyrolysis and gasification** are two important processes that are used to decompose materials. Both these processes are different from combustion because the combustion is carried out in the presence of an excessive amount of oxygen.
- **What is Pyrolysis?**
  - **Pyrolysis** is the process of thermal conversion of organic matter using a catalyst in the **absence of oxygen or near absence**. Therefore, it is the decomposition of material in an inert atmosphere. It is a chemical reaction that includes alteration of the chemical composition of the material**. Moreover, it is a reversible process.**
  - In pyrolysis, what we do is heating a material to a temperature above its decomposition temperature. It breaks down the chemical bonds of the material.
  - Therefore, this process usually forms small molecules from large fragments. But, these small molecules can combine, forming large molecular masses as well. For example, pyrolysis of triglycerides form alkanes, alkenes, alkadienes, aromatics and carboxylic acids.
  - Moreover, the process proceeds at temperatures ranging from **350°C – 600°C**
- **What is Gasification?**
  - Gasification is a thermo-chemical process that converts biomass into a combustible gas called producer gas (syngas). Here, the materials decompose in an environment where a **little amount of oxygen is present**. However, this amount of oxygen is not enough for combustion. The products of gasification are heat and combustible gas. The process proceeds at temperatures ranging from **800°C – 1200°C**.
  - The principle components in the combustible gas that forms during this process include carbon monoxide and hydrogen gas. In addition, there are some other components such as water vapour, carbon dioxide, tar vapour, ash, etc.

- Moreover, pyrolysis is useful for applications in food manufacturing, i.e. caramelization, production of fuel from biomass, production of ethylene, to treat plastic waste, etc. while gasification is useful for heat production, production of electricity, etc.

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

Q 10.D

- Bioindicators are organisms, such as lichens, birds and bacteria, that are used to monitor the health of the environment. The organisms and organism associations are monitored for changes that may indicate a problem within their ecosystem. The changes can be chemical, physiological or behavioural**. Bioindicators are relevant for Ecological health.**
- Bioindicators can be a measure, an index of measures, or a model that characterizes an ecosystem or one of its critical components. They are also a method of monitoring or detecting the negative impacts that industrial activity has on the environment. This information helps develop strategies that will prevent or lower such effects and make the industry more sustainable. The role of bioindicators in sustainable development will help ensure that industry leaves the smallest footprint possible on the environment.
- **Role of Bioindicators**
- If toxins are present, certain plants may not be able to grow in the area affected.
- Monitoring population numbers of animals may indicate damage to the ecosystem in which they live.
- Algae blooms are often used to indicate large increases of nitrates and phosphates in lakes and rivers.
- If pollution causes the reduction of an important food source, the animals dependent on it for food may also decrease. Animals may also change their behaviour or physiology if a toxin is present.
- The levels of certain liver enzymes in fish increase if they are exposed to pollutants in the water.
- **Few tolerant species like tubifex and insect larvae may survive in highly polluted water with low dissolved oxygen content . Hence they indicate polluted water**
- Microorganisms can also be used as indicators of toxins in an ecosystem. Some microorganisms will produce stress proteins if exposed to certain pollutants. By measuring the levels of stress proteins, we can get an idea of the level of pollution present in the environment.
  - **Examples of bioindicators : lichens , tubifex , insect larvae , frog , algal blooms etc .**
- **Hence all the statements are correct.**

Q 11.B

- **Recent context-** Delhi municipal corporation has started the process of "biomining and bioremediation" of the three landfills in Delhi namely Bhalswa, Okhla and Ghazipur.
- **Biomining is the process of using microorganisms (microbes) to extract metals of economic interest from rock ores or mine waste. Biomining techniques may also be used to clean up sites that have been polluted with metals. Hence statement (b) is the correct answer.**
- Valuable metals are commonly bound up in solid minerals. Some microbes can oxidize those metals, allowing them to dissolve in water. This is the basic process behind most biomining, which is used for metals that can be more easily recovered when dissolved than from the solid rocks.
- A different biomining technique, for metals which are not dissolved by the microbes, uses microbes to break down the surrounding minerals, making it easier to recover the metal of interest directly from the remaining rock.
- Most current biomining operations target valuable metals like copper, uranium, nickel, and gold that are commonly found in sulfidic (sulfur-bearing) minerals.
- Microbes are especially good at oxidizing sulfidic minerals, converting metals like iron and copper into forms that can dissolve more easily.
- Other metals, like gold, are not directly dissolved by this microbial process, but are made more accessible to traditional mining techniques because the minerals surrounding these metals are dissolved and removed by microbial processes.

- When the metal of interest is directly dissolved, the biomining process is called **"bioleaching**," and when the metal of interest is made more accessible or "enriched" in the material left behind, it is called **"biooxidation."** Both processes involve microbial reactions that can happen anywhere the microbes, rocks, and necessary nutrients, like oxygen, occur together.
- **Bioremediation** is the treatment of pollutants or waste (as in an oil spill, contaminated groundwater, or an industrial process) by the use of microorganisms (such as bacteria) that break down the undesirable substances.

Q 12.B

- Hydrogen is an environmentally friendly alternative to fossil fuels, and they can be used to power just about any machine needing energy. The fuel cell, which is the energy conversion device that can capture and use the power of hydrogen effectively is the key to making this happen.
- Hydrogen-powered fuel cells have two or three times the efficiency of traditional combustion technologies. For example, a conventional combustion-based power plant usually generates electricity between 33 to 35 per cent efficiency. Hydrogen fuel cells are capable of generating electricity of up to 65 per cent efficiency.
- Also, a gasoline-powered engine in a conventional car is not as efficient at converting chemical energy into gasoline into power that moves vehicles under normal driving conditions. With vehicles that use hydrogen fuel cells, and also use electric motors, are more efficient as they can use 40 to 60 per cent of the fuel's energy. As a result, there is more than a 50% reduction in fuel consumption.

Advantages of Hydrogen Fuel Cells:

- **It is readily available:** As mentioned earlier, hydrogen is a basic earth element and it's very abundant. However, it takes a whole lot of time to separate hydrogen gas from its companion substances. While that may be the case, the results produce a powerful clean energy source.
- **It doesn't produce harmful emissions:** When hydrogen is burned, it doesn't emit harmful substances. Basically, it reacts to oxygen without burning and the energy it releases can be used to generate electricity used to drive an electric motor. Also, it doesn't generate carbon dioxide when burnt, not unlike other power sources.
- **Environmentally friendly:** Hydrogen is a non-toxic substance which is rare for a fuel source. Others such as nuclear energy, coal and gasoline are either toxic or found in places that have hazardous environments. Because hydrogen is friendly towards the environment, it can be used in ways that other fuels can't even possibly match.
- **It can be used as fuel in rockets:** Hydrogen is both powerful and efficient. It is enough to provide power for powerful machines such as spaceships. Also, given that it is environmentally friendly, it is a much safer choice compared to other fuel sources. A fun fact: hydrogen is three times as powerful as gasoline and other fossil fuels. **This means that it can accomplish more with less.**
- It is fuel-efficient: Compared to diesel or gas, hydrogen is much more fuel-efficient as it can produce more energy per pound of fuel. This means that if a car is fueled by hydrogen, it can go farther than a vehicle loaded with the same amount of fuel but using a more traditional source of energy.
- **It is renewable**: Hydrogen can be produced again and again, unlike other non-renewable sources of energy. This means that with hydrogen, you get a fuel source that is limited. Basically, hydrogen energy can be produced on demand. Also, it is widely available – all that is needed is to break the water molecules so it gets separated from oxygen. It's without question a time-consuming process but the outcome is great.
- **Disadvantages of Hydrogen Fuel Cells**
    - **Expensive**: While widely available, hydrogen is expensive. A good reason for this is that it takes a lot of time to separate the element from others. If the process were really simple, then a lot would have been doing it with relative ease, but it's not.
    - **Difficult to store:** Hydrogen is very hard to move around. When speaking about oil, that element can be sent though pipelines. When discussing coal, that can be easily carried off on the back of trucks.

When talking about hydrogen, just moving even small amounts is a very expensive matter. For that reason alone, the transport and storage of such a substance is deemed impractical.

- **Highly flammable:** Since it is a very powerful source of fuel, hydrogen can be very flammable. In fact, it is on the news frequently for its many number of risks. Hydrogen gas burns in air at very wide concentrations – between 4 and 75 percent.
- **Dependent on fossil fuels:** Although hydrogen energy is renewable and has minimal environmental impact, other non-renewable sources such as coal, oil and natural gas are needed to separate it from oxygen. While the point of switching to hydrogen is to get rid of using fossil fuels, they are still needed to produce hydrogen fuel.

Q 13.D

- **A microbial fuel cell (MFC) is a bio-electrochemical device that harnesses the power of respiring microbes to convert organic substrates directly into electrical energy.** At its core, the MFC is a fuel cell, which transforms chemical energy into electricity using oxidation-reduction reactions. Microbial fuel cells are devices that use microbes, such as bacteria, as the catalysts to oxidize organic and inorganic matter and generate current.
- Microbial fuel cells rely on living biocatalysts to facilitate the movement of electrons throughout their systems instead of the traditional chemically catalyzed oxidation of fuel at the anode and reduction at the cathode. The most promising MFC's for commercialization in today's energy industry are mediators MFC's which use a special type of microorganism termed exoelectrogens. Exoelectrogens are electrochemically active bacteria.
- The operational and functional advantages of MFCs are:
  - MFCs use organic waste matter as fuels and readily available microbes as catalysts.
  - MFCs do not require highly regulated distribution systems like the ones needed for Hydrogen Fuel Cells.
  - MFCs have high conversion efficiency as compared to Enzymatic Fuel Cells, in harvesting up to 90% of the electrons from the bacterial electron transport system.
- Microbial fuel cells can be used in a variety of applications like-
  - to power a wide range of vital conservation tools remotely, including sensors, monitoring platforms, and camera traps.
  - in wastewater treatment: conditions of a wastewater treatment plant are ideal for the types of bacteria that can be used in an MFC. Exoelectrogens are more than happy to breakdown and metabolize the carbon-rich sewage of a wastewater stream to produce electrons that can stream into a cheap conductive carbon cloth anode.
  - **Powering underwater monitoring devices.**
  - **Power supply to remote sensors.**
  - BOD sensing- to use it as a sensor for pollutant analysis and in situ process monitoring and control.
  - **Bio-hydrogen production**
  - for the remediation of various environmental pollutants viz. antibiotics, synthetic dyes, phenolic compounds, nitrogen-based compounds, ethyl acetate, toluene, polycyclic aromatic hydrocarbons, perchlorate, pesticide, sulphur, emerging contaminants, trace organic compounds etc.

Q 14.C

Thermal Pollution

- **Thermal pollution** is defined as sudden increase or decrease in temperature of a natural body of water which may be ocean, lake, river or pond by human influence. This normally occurs when a plant or facility takes in water from a natural resource and puts it back with an altered temperature. Usually, these facilities use it as a cooling method for their machinery or to help better produce their products.

Effects

Decrease in the DO (Dissolved Oxygen) Levels

- Coldwater contains more oxygen than hot water so increases in temperature also **decrease the oxygen-carrying capacity of water (leads to anaerobic conditions in water bodies).** In addition, raising the water temperature increases the decomposition rate of organic matter in water, which also depletes dissolved oxygen. These decreases in the oxygen content of the water occur at the same time that **the metabolic rates of the aquatic organisms, which are dependent on sufficient oxygen supply, are rising because of the increasing temperature. Hence only options 2 and 3 are correct.**
- Ocean invertebrates, fish and marine reptiles are obligate poikilotherms -- their body temperatures depend entirely on the surrounding water. Each species is adapted to a single range of temperatures and many pass through several different life stages, each with an individual range of tolerance. The ocean's vast populations of microbes, fungi and sea plants also rely on narrow temperature ranges for optimal growth.
- Thermal pollution often temporarily increases aquatic plant populations. Other life forms, including microbes and animals, move into these regions to exploit the higher oxygen levels, but when photosynthesis stops at night or upon the death of plants, dissolved oxygen levels plummet, leading to massive animal die-offs. Excess heat can also cause unnaturally large microbial blooms, which kill animals by depleting local oxygen or producing toxins.

Q 15.D

- **United Nations Framework Classification (UNFC)**
  - UNFC is a global, principles-based and user-friendly system for classifying, managing, and reporting mineral, petroleum, renewable energy, anthropogenic resources, and injection projects. **Hence option (d) is the correct answer.**
  - It was adopted in 2004 by the United Nations Economic Commission of Europe (UNECE).
  - The UNFC consists of a three-dimensional system with the following three axes:
    - G Axis: Geological Assessment i.e. reconnaissance, prospecting, general exploration, and detailed exploration.
    - F Axis: Feasibility assessment studies
    - E Axis: Economic viability
  - The UNFC system is used for:
    - Policy formulation in energy and raw material studies
    - National resources management functions
    - Corporate business processes
    - Financial Reporting
  - UNFC currently applies to minerals, petroleum, renewable energy, nuclear fuel resources, injection projects for geological storage, and anthropogenic resources.

Q 16.B

- Ecosystems are places where plants, animals, and other organisms, in conjunction with the landscape around them, come together to form the web of life. They exist at all scales, from a grain of soil to the entire planet.
- The UN Decade focuses on restoration in eight broad categories of ecosystems: (i) farmlands (ii) forests (iii) freshwater (iv) grasslands, shrublands, and savannahs (v) mountains (vi) oceans and coasts (vii) peatlands (viii) urban areas. **Hence statement 1 is not correct.**
- Three main goals underpin the vision of the UN Decade's Strategy:
  - Goal 1: Enhancing global, regional, national, and local commitments and actions to prevent, halt, and reverse the degradation of ecosystems.
  - Goal 2: Increasing our understanding of the multiple benefits of successful ecosystem restoration.
  - Goal 3: Applying this knowledge in our education systems and within all public and private sector decision-making.

- By achieving these goals, the UN Decade will assist societies globally to embark on a new ecological, economic, and social trajectory throughout the 21st century and beyond. **Hence statement 2 is correct**.
- It follows a **10-point action strategy which includes the following elements. Hence statement 3 is correct.**
    1. Empower a global movement.
    2. Finance restoration on the ground.
    3. Set the right incentives.
    4. Celebrate leadership.
    5. Shift behaviors.
    6. Invest in research.
    7. Build up capacity.
    8. Celebrate a culture of restoration.
    9. Build up the next generation.
    10. Listen and learn.
- **Hence option (c) is the correct answer.**

Q 17.B

- Bio-medical waste includes human and animal anatomical waste, laboratory and microbiological waste, blood samples, syringes, needles, soiled waste, and other materials generated during healthcare activities.
- **Applicability: Applicable to all persons and entities generating, collecting, receiving, storing, transporting, treating, disposing, or handling bio-medical waste.**
    - **Covers healthcare facilities (HCFs) like hospitals, nursing homes, clinics, blood banks, veterinary institutions, and diagnostic labs.**
- **Exclusions: Does not apply to radioactive waste, municipal solid waste, hazardous waste, e-waste, or lead-acid batteries.**
- Classification of Waste: Waste is segregated into 4 categories (reduced from the earlier 10 categories):
    - Yellow: Human/animal anatomical waste, soiled waste.
    - Red: Contaminated recyclable waste.
    - White: Sharps like needles and scalpels.
    - Blue: Glassware and metallic implants.
- **Under India's Bio-medical Waste Management Rules, 2016, biomedical waste must be treated within 48 hours of its generation to prevent contamination and minimize risks to human health and the environment.**
- **Segregation and Treatment Time Limit: The rules state that no untreated bio-medical waste shall be stored beyond 48 hours. This ensures prompt treatment and disposal of waste to avoid contamination and other associated risks.**
- **Exception: If it becomes necessary to store waste beyond this period due to unavoidable circumstances, the authorized person must:**
    - **Obtain permission from the prescribed authority.**
    - **Take measures to prevent adverse effects on human health and the environment.**
- **Hence option (b) is the correct answer.**

Q 18.D

- **Phytoremediation** refers to using plants and associated soil microbes to reduce the concentrations or toxic effects of contaminants in the environment. Phytoremediation is widely accepted as a cost-effective environmental restoration technology. Phytoremediation is an alternative to engineering procedures that are usually more destructive to the soil.
- **Phytovolatilization** involves the uptake of contaminants by plant roots and their conversion to a gaseous state and release into the atmosphere. The evapotranspiration of plants drives this process. Plants that have high evapotranspiration rates are sought after in phytovolatilization. Organic contaminants, especially volatile organic compounds (VOCs) are passively volatilized by plants. For example, hybrid poplar trees

have been used to volatilize trichloroethylene (TCE) by converting it to chlorinated acetates and CO2. **Hence statement 1 is correct.**

- **Phytoextraction** uses the ability of plants to accumulate contaminants in the aboveground, harvestable biomass. This process involves repeated harvesting of the biomass to lower the concentration of contaminants in the soil. Phytoextraction is either a continuous process (using metal hyperaccumulating plants or fast-growing plants) or an induced process (using chemicals to increase the bioavailability of metals in the soil). **Hence statement 2 is correct.**
- **Hybrid poplar**, **willows**, **sunflower**, **alpine pennycress**, **clover**, **Indian mustard**, **redroot pigweed**, and **ferns** have been identified by the Indian Council of Agriculture Research (ICAR) to be plants of choice for **commercial phytoremediation applications. Hence statement 3 is correct.**

Q 19.D

- The '**polluter pays**' principle is the commonly accepted practice that those who produce pollution should bear the costs of managing it to prevent damage to human health or the environment. For instance, a factory that produces a potentially poisonous substance as a by-product of its activities is usually held responsible for its safe disposal. The **Polluter-Pays Principle (PPP) was first adopted by the OECD in 1972** as an economic principle for allocating pollution control costs. **Hence statement 1 is correct.**
- The polluter pays principle is part of broader principles to guide **sustainable development** worldwide (formally known as the **1992 Rio Declaration**). The principle underpins most of the regulations on pollution affecting land, water, and air. **Hence statement 2 is correct.**
- The polluter pays principle can be applied to greenhouse gas emitters through '**carbon price**.' The carbon price can make the polluter pay through two different policy instruments. The first is a price-based mechanism in the form of a **carbon tax,** where the tax rate for each tonne of greenhouse gas emitted determines the price of pollution. The second is through a quota-based system, often called a **cap-and-trade or emissions trading system**. This sets a cap, or limit, on the maximum level of emissions for a given time period and distributes permits or allowances for each unit of greenhouse gas among firms that produce emissions. **Hence statement 3 is correct.**

Q 20.C

- Ozone high in the Earth's atmosphere protects us from the sun's harmful radiation. But at ground level, ozone is an air pollutant that harms people and plants. **Ground-level ozone forms when nitrogen oxides and volatile organic compounds react in sunlight and hot temperatures.** This pollution comes from vehicles, industry, and other sources and contributes to smog formation. **Hence statement 1 is correct.**
- Emerging evidence has shown that both short-term and long-term exposures to ozone, at concentrations below the current regulatory standards, were associated with increased mortality due to **respiratory and cardiovascular diseases**. **Ozone is a strong oxidant** that induces oxidative damage to cells and the lining fluids of the airways and immune-inflammatory responses within and beyond the lung. **Hence statement 2 is correct.**

Q 21.A

- The main **anthropogenic sources of soil pollution** are the chemicals used in or produced as byproducts of industrial activities, domestic, livestock, and municipal wastes (including wastewater), agrochemicals, and petroleum-derived products. These chemicals are released to the environment accidentally, for example, from oil spills or leaching from landfills, or intentionally, as is the case with fertilizers and pesticides, irrigation with untreated wastewater, or land application of sewage sludge. Soil pollution also results from **atmospheric deposition from smelting**, transportation, spray drift from pesticide applications, and incomplete combustion of many substances as well as **radionuclide deposition from atmospheric weapons** testing and nuclear accidents. **Hence statement 1 is correct.**
- The **Global Soil Partnership (GSP)** is a globally recognized mechanism established in 2012 to position soils in the Global Agenda and promote sustainable soil management. The Partnership, hosted by **FAO (Food and Agriculture Organization)**, works hard to improve soil governance to guarantee productive

soils towards food security, climate change adaptation and mitigation, and sustainable development for all. **Hence statement 2 is not correct.**

- Overuse of soil and erosion are examples of **negative soil pollution**. The two variables that cause soil erosion are water and air. **Positive soil pollution** is caused by (i) pesticides, herbicides, and fumigants, (ii) chemical fertilizers, and (iii) Air pollutants washed down from the atmosphere through rain.

Q 22.D

- **Hazardous and Other Wastes (Management & Trans boundary Movement) Rules, 2016**
- The ambit of the Rules has been expanded by including 'Other Waste'.
- Procedure has been simplified to merge all the approvals as a single window clearance for setting up of hazardous waste disposal facility and import of other wastes.
- The process of import/export of waste under the Rules has been streamlined by simplifying the document-based procedure and by revising the list of waste regulated for import/export.
- The import of metal scrap, paper waste and various categories of electrical and electronic equipments for re-use purpose has been exempted from the need of obtaining Ministry's permission.
- Responsibilities of State Government for environmentally sound management of hazardous and other wastes have been introduced as follows:
  - To set up/ allot industrial space or sheds for recycling, pre-processing and other utilization of hazardous or other waste.
  - To register the workers involved in recycling, pre-processing and other utilization activities.
  - To form groups of workers to facilitate setting up such facilities.
  - To undertake industrial skill development activities and ensure safety and health of workers.
- The following items have been prohibited for import:
  - **Waste edible fats and oil of animals, or vegetable origin**
  - **Household waste**
  - **Used critical Care Medical equipment**
  - Waste pneumatic tyres for direct reuse
  - Solid Plastic wastes including Pet bottles
  - Waste electrical and electronic assemblies scrap
  - Other chemical wastes especially in solvent form
    - **Waste halogenated organic solvents**
- **Hence option (d) is the correct answer.**

Q 23.B

- Lead pollution occurs when lead, a toxic heavy metal, contaminates air, water, or soil due to human activities like mining, smelting, industrial emissions, and improper waste disposal.
- Sources:
  - Lead-based paints. Lead-acid batteries (improper disposal and recycling). Leaded gasoline (phased out in most countries). Contaminated water systems (e.g., lead pipes). E-waste and industrial emissions.
- Health Impacts:
  - Children: Affects brain development, leading to reduced IQ, behavioral issues, and learning disabilities.
  - Adults: Can cause high blood pressure, kidney damage, and fertility issues.
  - Pregnant Women: Leads to miscarriage, premature birth, or developmental issues in infants.
- **Lead is a heavy metal, not a Persistent Organic Pollutant (POP). POPs are organic chemicals (e.g., DDT, PCBs) that resist environmental degradation, accumulate in living organisms, and pose risks to human health and ecosystems.**
  - **Lead, while harmful and persistent in the environment, is classified separately as a toxic heavy metal. Hence statement 1 is not correct.**
- **Phytoremediation is an effective and eco-friendly method to manage soil contamination, where plants like Indian mustard or sunflowers absorb lead and store it in their tissues.** This technique

reduces lead concentrations in the soil and prevents further contamination of water and food chains. **Hence statement 2 is correct**

- **According to WHO, lead exposure is unsafe at any level, especially for children and pregnant women.**
  Lead is a cumulative toxicant affecting the brain, kidneys, liver, and bones, and even low exposure levels can result in cognitive impairment and developmental delays. Hence statement 3 is correct.

Q 24.B

- The Montreal Protocol on Substances that Deplete the Ozone Layer, adopted in 1987 and enforced in 1989, is an international treaty aimed at protecting the ozone layer by phasing out the production and consumption of ozone-depleting substances (ODS).
  - Objective: To phase out ODS like chlorofluorocarbons (CFCs), halons, and hydrochlorofluorocarbons (HCFCs).
- **The Montreal Protocol phases down the consumption and production of the different ODS in a step-wise manner, with different timetables for developed and developing countries (referred to as "Article 5 countries"). Hence statement 2 is correct.**
- Under this treaty, all parties have specific responsibilities related to the phase out of the different groups of ODS, control of ODS trade, annual reporting of data, national licensing systems to control ODS imports and exports, and other matters.
  - **Developing and developed countries have equal but differentiated responsibilities, but most importantly, both groups of countries have binding, time-targeted, and measurable commitments.**
  - **The Parties are assisted by the Ozone Secretariat, which is based at UN Environment Programme headquarters in Nairobi, Kenya.**
- **The Multilateral Fund for the Implementation of the Montreal Protocol was established in 1991 under Article 10 of the treaty**.
  - **The Fund's objective is to provide financial and technical assistance to developing country parties to the Montreal Protocol** whose annual per capita consumption and production of ODS is less than 0.3 kg to comply with the control measures of the Protocol. **Hence statement 1 is not correct.**
  - **GEF was established during the Rio Earth Summit of 1992. It is based in Washington, D.C., United States. The GEF is jointly managed by the United Nations Development Programme (UNDP), the World Bank, and the United Nations Environment Programme (UNEP)**
- Phase-Out of HCFCs – Montreal Amendment
  - Phase-Out Timelines:
    - > Developed Countries: Started reductions earlier, completed phase-out by 2020.
    - > Developing Countries (Article 5): Began reductions in 2013 with a complete phase-out by 2030.
- Phase-Down of HFCs – Kigali Amendment
  - Phase-Down Timelines:
    - > Developed Countries: Began reductions in 2019.
    - > Developing Countries:
      - ✓ Consumption freeze in 2024.
      - ✓ Some countries (Group 2) will follow in 2028.
    - > Gradual reduction targets: 80-85% by 2047.

Q 25.D

- The Rotterdam Convention on the Prior Informed Consent (PIC) Procedure for Certain Hazardous Chemicals and Pesticides in International Trade is an international treaty designed to promote shared responsibility and cooperation in regulating the global trade of hazardous chemicals. It ensures that importing countries have the right to refuse or restrict the import of certain dangerous substances.

- Adoption and Entry into Force:
  - Adopted: September 10, 1998
  - Came into force: February 24, 2004
  - Secretariat: Jointly managed by the Food and Agriculture Organization (FAO) and the United Nations Environment Programme (UNEP).
- Scope:
  - Focuses on:
    - Pesticides: Includes banned or severely restricted pesticides that pose risks to health or the environment.
    - **Industrial Chemicals: Covers hazardous industrial chemicals that have adverse effects.**
    - **The convention covers both categories. Annex III lists hazardous substances for which the PIC procedure is mandatory, including industrial chemicals (e.g., PCBs) and pesticides (e.g., DDT). Hence statement 3 is correct.**
  - Does not ban chemicals or regulate their domestic use, but ensures countries have control over import/export decisions.
- Voluntary Compliance:
  - **The convention lacks punitive mechanisms for non-compliance and relies on voluntary cooperation.**
  - **The Rotterdam Convention does not impose legally binding penalties for countries that violate its provisions. Instead, it relies on voluntary cooperation, reporting, and transparency. Hence statement 1 is correct.**
- Annexes of the Rotterdam Convention
  - Annex I: Lists information required for a notification of a banned or severely restricted chemical.
  - Annex II: Specifies the criteria for listing chemicals under Annex III.
  - **Annex III: Contains the list of chemicals and pesticides subject to the PIC procedure.**
    - **Examples: Pesticides: Aldrin, DDT, Chlordane, Heptachlor. Industrial Chemicals: Polychlorinated biphenyls (PCBs), Asbestos.**
    - **A country can list a pesticide or industrial chemical under Annex III and continue to produce or use it domestically. The convention regulates international trade, not domestic policies. Hence statement 2 is correct.**
  - Annex IV: Provides the information required for export notifications.
  - Annex V: Describes the arbitration process for disputes under the convention.
  - Annex VI: Outlines procedures and institutional mechanisms for handling non-compliance.

Q 26.D

- Animals rely heavily on sounds to communicate, to find food, avoid predators, etc. Pets react more aggressively due to exposure to constant noise. They become disoriented more easily and face many behavioral problems. Overexposure to high-intensity noise affects the hearing ability of many animals. Man-made **noise affects mating calls and echolocation**. **This leads to a reduction in survival and reproduction rates.** At an ecosystem level, **noise pollution could lead to migration of animals**. Their **migration can affect crop production**. Because many animals, such as bats, pollinate bananas, peaches, agave, and other cash crops.
- The **noise booms** cause cracks in the walls of buildings and hills. **Sonic booms can break window panes and buildings**.
- Researchers and clinicians at Harvard University have shown that noise pollution not only drives hearing loss, **tinnitus**, and hypersensitivity to sound in human beings but can cause or exacerbate cardiovascular disease; type 2 diabetes; **sleep disturbances**; stress; mental health and **cognition problems**, including **memory impairment** and attention deficits; **childhood learning delays**; and low birth weight.
- **Hence option (d) is the correct answer.**

Q 27.C

- The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal is a landmark international treaty adopted to regulate and reduce the movement of hazardous waste between countries, particularly from developed to developing nations. It addresses environmental justice concerns and seeks to ensure environmentally sound management of hazardous waste.
- Objective:
  - To protect human health and the environment by regulating the transboundary movement of hazardous waste and ensuring its environmentally sound management.
  - To prevent the dumping of hazardous waste in developing countries by developed nations.
- Adoption and Entry into Force:
  - Adopted: March 22, 1989
  - Came into force: May 5, 1992
  - Secretariat: United Nations Environment Programme (UNEP)
- Scope of the Convention:
  - Hazardous Wastes Covered: Wastes classified as hazardous under Annex I of the convention (e.g., chemical wastes, heavy metals, medical waste, and electronic waste). Wastes that are explosive, flammable, toxic, corrosive, or ecotoxic.
  - **Exclusions: Radioactive waste (regulated by other frameworks like the IAEA). Household waste (unless explicitly included by a party's national laws). Hence statement 2 is correct.**
- Core Provisions:
  - Transboundary Movement: Requires prior informed consent (PIC) from the importing and transit countries before hazardous waste can be exported. Parties can prohibit the import of hazardous waste into their territories.
  - Environmentally Sound Management (ESM): Promotes the treatment, recycling, and disposal of hazardous waste in an environmentally responsible manner within the exporting country.
  - Minimization of Waste: Encourages countries to reduce the generation of hazardous waste at its source.
- **Basel Ban Amendment Adopted: 1995 (Part of the Basel Convention but introduced later as an amendment).**
  - **It specifically prohibits the export of hazardous waste from developed countries (Annex VII countries) to developing countries (non-Annex VII countries) for any reason, including recycling or disposal. Hence statement 3 is correct.**
- **The United States has signed the Basel Convention but has not ratified it. Therefore, it is not legally bound by the obligations of the convention. Hence statement 1 is correct**

Q 28.B

- **Autoclaving is a thermal disinfection process that uses high-pressure steam to sterilize infectious waste, making it one of the most effective and environmentally friendly methods for managing biomedical waste.**
  - Autoclaving uses saturated steam under pressure to raise the temperature of the waste to levels that kill pathogens, including bacteria, viruses, fungi, and spores.
  - Typical autoclaving conditions involve a temperature of 121°C to 134°C and a pressure of 15-20 psi for 15–60 minutes, depending on the load.
- Applications in Bio-Medical Waste Management
  - Infectious Waste:
    - > Used to sterilize waste generated from hospitals, laboratories, and healthcare facilities, such as Used surgical instruments.
    - > Contaminated dressings and gauze. Microbiological cultures and laboratory waste.
  - Non-Incinerable Waste: Treats materials like plastics and sharps (e.g., syringes) without combustion, making it more eco-friendly than incineration.

- While autoclaving sterilizes plastic waste, it does not convert it into reusable forms. Post-autoclaving, plastics must undergo separate recycling.
- **Hence option (b) is the correct answer.**

Q 29.A

- Battery Waste Management Rules, 2022
- **The rules cover all types of batteries, viz. Electric Vehicle batteries, portable batteries, automotive batteries and industrial batteries. Hence statement 1 is not correct.**
- **The rules function based on the concept of Extended Producer Responsibility (EPR) where the producers (including importers) of batteries are responsible for collection and recycling/ refurbishment of waste batteries and use of recovered materials from wastes into new batteries. Hence statement 2 is not correct.**
- **EPR mandates that all waste batteries to be collected and sent for recycling/refurbishment, and its prohibits disposal in landfills and incineration**. **Hence statement 3 is correct.**
    - To meet the EPR obligations, producers may engage themselves or authorise any other entity for collection, recycling or refurbishment of waste batteries.
- The rules will enable setting up a mechanism and centralized online portal for exchange of EPR certificates between producers and recyclers/refurbishers to fulfil the obligations of producers.
- The rules promote setting up of new industries and entrepreneurship in collection and recycling/refurbishment of waste batteries.
- Mandating the minimum percentage of recovery of materials from waste batteries under the rules will bring new technologies and investment in recycling and refurbishment industry and create new business opportunities.
- Prescribing the use of certain amount of recycled materials in making of new batteries will reduce the dependency on new raw materials and save natural resources.
- On the principle of Polluter Pays Principle, environmental compensation will be imposed for non-fulfilment of Extended Producer Responsibility targets, responsibilities and obligations set out in the rules. The funds collected under environmental compensation shall be utilised in collection and refurbishing or recycling of uncollected and non-recycled waste batteries.

Q 30.B

- **Plastic Waste Management Rules, 2016**
    - Increase minimum thickness of plastic carry bags from 40 to 50 microns and stipulate minimum thickness of 50 micron for plastic sheets also to facilitate collection and recycle of plastic waste
    - Expand the jurisdiction of applicability from the municipal area to rural areas, because plastic has reached rural areas also
    - To bring in the responsibilities of producers and generators, both in plastic waste management system and to introduce collect back system of plastic waste by the producers/brand owners, as per extended producers responsibility
    - To introduce collection of plastic waste management fee through pre-registration of the producers, importers of plastic carry bags/multilayered packaging and vendors selling the same for establishing the waste management system
    - To promote use of plastic waste for road construction as per Indian Road Congress guidelines or energy recovery, or waste to oil etc. for gainful utilization of waste and also address the waste disposal issue; to entrust more responsibility on waste generators, namely payment of user charge as prescribed by local authority, collection and handing over of waste by the institutional generator, event organizers.
    - An eco-friendly product, which is a complete substitute of the plastic in all uses, has not been found till date. In the absence of a suitable alternative, it is impractical and undesirable to impose a blanket ban on the use of plastic all over the country. The real challenge is to improve plastic waste management systems.

- Extended Producer Responsibility: Earlier, EPR was left to the discretion of the local bodies. First time, the producers (i.e persons engaged in manufacture, or import of carry bags, multi-layered packaging and sheets or like and the persons using these for packaging or wrapping their products) and brand owners have been made responsible for collecting waste generated from their products. They have to approach local bodies for formulation of plan/system for the plastic waste management within the prescribed timeframe.
- State Pollution Control Board (SPCBs) will not grant/renew registration of plastic bags, or multi-layered packaging unless the producer proposes the action plan endorsed by the concerned State Development Department.

- **Plastic Waste Management (Amendment) Rules 2018**
  - The amended Rules lay down that the phasing out of Multilayered Plastic (MLP) is now applicable to MLP, which are "non-recyclable, or non-energy recoverable, or with no alternate use."
  - The amended Rules also prescribe a central registration system for the registration of the producer/importer/brand owner.
- **Plastic Waste Management Amendment Rules, 2021**
  - The rules prohibits identified single use plastic items which have low utility and high littering potential by 2022.
  - The manufacture, import, stocking, distribution, sale and use of following single-use plastic, including polystyrene and expanded polystyrene, commodities shall be prohibited with effect from the 1st July, 2022:-
    - **ear buds with plastic sticks,** plastic sticks for balloons, plastic flags, candy sticks, ice-cream sticks, **polystyrene [Thermocol] for decoration;**
    - plates, cups, glasses, **cutlery such as forks, spoons, knives**, straw, trays, wrapping or packing films around sweet boxes, invitation cards, and cigarette packets, plastic or PVC banners less than 100 micron, stirrers.
- **Plastic bags below 120 microns in thickness are banned. The rules mandate that plastic carry bags must have a minimum thickness of 120 microns to encourage reuse and reduce littering.**
- **Hence option (b) is the correct answer.**

Q 31.D

- **High-Density Polyethylene (HDPE)**
  - Properties: Strong, durable, and lightweight plastic. Resistant to moisture, chemicals, and UV radiation.
  - Applications: Commonly used in products like milk jugs, detergent bottles, shampoo bottles, and some grocery bags.
  - **Recyclability: Highly recyclable. HDPE is one of the easiest plastics to recycle due to its simple chemical structure and high demand for recycled products. Recycling HDPE can produce products like piping, plastic lumber, and new containers.**
  - **Hence option 2 is correct.**
- **Polyethylene Terephthalate (PET)**
  - Properties: Transparent, lightweight, and durable plastic. Known for its strength and impermeability to liquids.
  - Applications: Widely used in beverage bottles, food containers, and synthetic fibers.
  - **Recyclability: Highly recyclable. PET is extensively recycled worldwide. The recycling process is efficient and produces high-quality recycled material for making new bottles, textiles, and packaging. Recycled PET (rPET) is in high demand due to its use in eco-friendly packaging solutions.**
  - **Hence option 3 is correct.**
- **Polystyrene (PS)**
  - Properties: Lightweight, brittle, and versatile plastic. Commonly used in both rigid (disposable cups, cutlery) and expanded forms (Styrofoam).

- Applications: Found in disposable coffee cups, egg cartons, takeout food containers, and packaging peanuts.
- **Recyclability: Limited recyclability. Polystyrene is challenging to recycle due to its low density and contamination from food or liquids. Expanded Polystyrene (EPS) is even more problematic due to its high volume-to-weight ratio, making collection and transportation inefficient.**
- **Hence option 1 is not correct.**

- **Polyvinyl Chloride (PVC)**
  - Properties: A versatile and chemically stable plastic, but it contains chlorine and additives like phthalates.
  - Applications: Commonly used in plumbing pipes, window frames, flooring, and medical equipment.
  - **Recyclability: Low recyclability. Recycling PVC is difficult and expensive because of the need to separate harmful additives and manage toxic byproducts. Recycling is rarely performed due to the potential release of dioxins and other hazardous substances during processing.**
  - **Hence option 4 is not correct.**

Q 32.A

- The Stockholm Convention on Persistent Organic Pollutants (POPs) is a global treaty adopted in 2001 to protect human health and the environment from harmful chemicals.
  - It focuses on eliminating or restricting the production, use, and release of Persistent Organic Pollutants (POPs)—toxic chemicals that persist in the environment, bioaccumulate in living organisms, and pose risks to health and ecosystems.
- Scope:
  - Covers pesticides (e.g., DDT), industrial chemicals (e.g., PCBs), and by-products (e.g., dioxins and furans).
- **The Stockholm Convention has three annexes that classify chemicals and specify how they should be controlled.**
  - **Annexes:**
    - **Annex A (Elimination): Chemicals to be phased out completely (e.g., aldrin, mirex).**
    - **Annex B (Restriction): Chemicals with restricted use (e.g., DDT for malaria control).**
    - **Annex C (Unintentional Production): Chemicals to be minimized (e.g., dioxins).**
  - **Hence statement 2 is correct**
- Implementation Mechanisms:
  - Parties must create National Implementation Plans (NIPs) to regulate POPs.
  - Monitoring and reporting of POPs' production and release.
  - Promote environmentally sound waste disposal.
- **The Stockholm Convention does not impose an immediate and universal ban on all listed POPs. It provides phased timelines for elimination, allows specific exemptions, and permits restricted use for essential purposes. Hence statement 1 is not correct**
  - For example DDT (Annex B): Permitted for vector control in malaria-endemic countries.
  - PCBs (Annex A): Phased elimination by 2025 with conditional use in electrical equipment.
- Funding and Support:
  - The Global Environment Facility (GEF) provides financial assistance for implementation, particularly to developing countries.
- Kigali Amendment (Expanding Scope):
  - Added chemicals like PFOS (perfluorooctane sulfonic acid) and newer pollutants to address emerging threats.
  - **While most POPs are man-made, some can occur naturally:**
    - **Examples: Dioxins: Released during volcanic eruptions or forest fires.**
    - **Polycyclic Aromatic Hydrocarbons (PAHs): Produced during the incomplete combustion of organic matter.**
- **Hence statement 3 is not correct.**

Q 33.B

- Salient features of Solid Waste Management Rules, 2016
- Applicability: Extends beyond municipal areas to urban agglomerations, census towns, industrial townships, airports, ports, defense establishments, SEZs, government organizations, and places of religious/historical importance.
- Prohibited Actions: No throwing, burning, or burying of solid waste in public spaces, drains, or water bodies.
- Responsibilities of Generators: Pay user fees and spot fines for littering or non-segregation. Wrap sanitary waste (diapers, pads) in manufacturer-provided pouches and dispose in dry waste bins. Bulk and institutional generators must partner with local bodies for waste segregation and management.
- **Duties of Waste Generators**
  - **Segregate waste into three categories:**
    - **Bio-degradable waste (e.g., food and organic waste).**
    - **Non-biodegradable waste (e.g., plastics, paper, metal).**
    - **Domestic hazardous waste (e.g., diapers, sanitary pads).**
  - **Handover segregated waste to authorized waste pickers or collectors as directed by local authorities.**
- Hotels and Restaurants: Segregate biodegradable waste for composting or bio-methanation.
- Resident Welfare Associations (RWAs) and Institutions: Premises larger than 5,000 sq.m must segregate waste and hand over recyclables to authorized waste pickers or recyclers. Process biodegradable waste within premises as far as possible.
- New Townships and Group Housing Societies: Must develop in-house systems for managing biodegradable waste.
- Street Vendors: Keep suitable containers for waste and deposit them at designated waste collection points.
- Special Economic Zones (SEZs) and Industrial Areas: Reserve 5% of the total area for waste recovery and recycling facilities.
- Manufacturer Responsibilities: Provide financial assistance to local authorities for waste management systems. Collect back non-biodegradable packaging waste generated from their products. Use recyclable materials in sanitary napkins and diapers or provide disposal pouches with products.
- Industrial Units: Within 100 km of an RDF (Refuse-Derived Fuel) plant, replace at least 5% of fuel requirements with RDF. High calorific waste (>1500 Kcal/kg) to be used for energy generation or co-processing in cement/thermal plants.
- Construction and Demolition Waste: To be stored and disposed of separately as per the Construction and Demolition Waste Management Rules, 2016.
- Horticulture Waste: Disposed of as per local authority guidelines.
- Event Organizers: For gatherings of more than 100 people, ensure waste segregation and handover to authorized collectors.
- Hilly Areas: Avoid landfills on hills; set up transfer stations for residual waste. Residual waste to be transported to a sanitary landfill in plain areas within 25 km.
- **Hence option (b) is the correct answer.**

Q 34.B

- The **End Plastic Pollution International Collaborative (EPPIC)** is a public-private partnership hosted by the **International Union for the Conservation of Nature (IUCN)** with partners the **Aspen Institute (USA)**, **The Ocean Foundation (USA)**, and **Searious Business (NL)**, with initial seed funding from the U.S. Department of State. EPPIC seeks to galvanize global action on plastic pollution by supporting projects around the world to make the full lifecycle of plastic more sustainable, starting with efforts to change the design and use of plastic products. **Hence statement 1 is not correct.**
- The Great Pacific Garbage Patch is a gyre of plastic debris in the north-central Pacific Ocean. It's the largest accumulation of plastic in the world. Also known as the Pacific trash vortex, the garbage patch is

actually two distinct collections of debris bounded by the massive North Pacific Subtropical Gyre**. Hence, statement 2 is correct.**

- **Intergovernmental Negotiating Committee (INC):** In March 2022, at the resumed **fifth session of the UN Environment Assembly** (UNEA-5.2), a historic resolution was adopted to develop an **international legally binding instrument on plastic pollution**, including in the marine environment. The resolution requested the Executive Director of the **UN Environment Programme (UNEP)** to convene an **Intergovernmental Negotiating Committee (INC)** to develop "the instrument," which is to be based on a comprehensive approach that addresses the full life cycle of plastic, including its production, design, and disposal. The **fifth session (INC-5)** is scheduled for 25 November to 1 December 2024 in **Busan, Republic of Korea**.
  - The INC is expected to present a legally binding instrument, which would reflect diverse alternatives to address the full lifecycle of plastics, the design of reusable and recyclable products and materials, and the need for enhanced international collaboration to facilitate access to technology, capacity building, and scientific and technical cooperation.
  - Under the legally binding agreement, countries will be expected to develop, implement, and update national action plans reflecting country-driven approaches to contribute to the instrument's objectives.
  - They will be expected to promote national action plans to work towards preventing, reducing, and eliminating plastic pollution and to support regional and international cooperation.

Q 35.A

- **The Bamako Convention on the Ban of the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa (Bamako Convention) is a treaty of African nations, which prohibits the import into Africa of any hazardous (including radioactive).**
  - **It was negotiated by 12 nations of the African Union (formerly Organization of African Unity) in Bamako, Mali, 30 January 1991. The Convention entered into force on 22 April 1998.**
- The Bamako Convention urges member states to effectively manage and restrict the cross-border transport of hazardous wastes across Africa. Encompassing a broader range of wastes than the Basel Convention, it addresses the shortcomings identified in Article 11 of the latter, offering a comprehensive response to the continent's environmental challenges.
- The Convention specifically encourages Member States: To minimize and control transboundary movements of hazardous wastes within the African continent.
  - To prohibit all ocean and inland water dumping or incineration of hazardous wastes;
  - To ensure that disposal of wastes is conducted in an “environmentally sound manner;
  - To promote cleaner production over the pursuit of a permissible emissions approach based on assimilative capacity assumptions;
  - To establish the precautionary principle.
- The Convention covers more wastes than covered by the Basel Convention as it not only includes radioactive wastes but also considers any waste with a listed hazardous characteristic or a listed constituent as a hazardous waste.
  - The Convention also covers national definitions of hazardous waste. Finally, products that are banned severely restricted or have been the subject of prohibitions are also covered under the Convention as wastes.
- **Hence option (a) is the correct answer.**

Q 36.B

- The Ministry of Environment, Forest and Climate Change (MoEFCC) brought out notifications in 1989 with the purpose of prohibition/restricting the operations of certain industries to protect ecologically sensitive **Doon Valley**. The notification introduced the **concept of categorization of industries** as " **Red**," "**Orange**," and "**Green**" to facilitate decisions related to the location of these industries. Subsequently, the application of this concept was extended to other parts of the country not only to

identify industries but also for consent management and formulation of norms related to the surveillance/inspection of industries.

- The concept of categorization of industries continued to evolve and as different State Pollution Control Boards interpreted it differently, a need arose to bring about necessary uniformity in its application across the country. In order to harmonize the "Criteria of categorization" " directions were issued by CPCB under the Water (Prevention & Control of Pollution), Act, 1974 to all SPCBs/PCCs to maintain uniformity in the categorization of industries as red, green, and orange as per list finalized by CPCB.
- MoEFCC, in consultation with the state pollution control boards and different government and non-government organizations, finalized the following criteria on the range of pollution indexes for the purpose of categorization of the industrial sector:
  - Industrial Sectors having **Pollution Index score of 60 and above - Red category**
  - Industrial Sectors having **Pollution Index score of 41 to 59 - Orange category**
  - Industrial Sectors having **Pollution Index score of 21 to 40 - Green category**
  - Industrial Sectors having Pollution Index score incl.&upto 20 - White category
- **Hence option (b) is the correct answer.**

Q 37.C

- **Downcycling is the process of recycling a material into a product of lower quality, reduced value, or diminished functionality compared to the original material.**
  - **While it prevents the material from being wasted completely, the resulting product often has limited future recycling or usage potential.**
- How Downcycling Works:
  - Recycling Process: Materials are collected, processed, and converted into new products. However, during this process, the material's quality often degrades due to:
    - Loss of structural integrity (e.g., fibers in paper or textiles becoming shorter)
    - Contamination from mixed materials or impurities
    - Thermal or chemical degradation (e.g., plastics exposed to heat during recycling)
- End Product: The recycled material may only be suitable for lower-value applications, making it harder or impossible to recycle again.
- Examples of Downcycling:
  - Plastic:
    - High-quality plastics from beverage bottles (e.g., PET) may be recycled into items like carpeting or fleece clothing. These items are typically not recyclable further.
  - Metal:
    - Scrap metals like aluminum from cans may be recycled into alloys for products such as construction materials, which often lack the purity of the original material.
- Downcycling vs. Upcycling:
  - Downcycling: Reduces material quality (e.g., turning office paper into cardboard).
  - Upcycling: Enhances material value by creatively reusing or repurposing materials without degrading quality (e.g., turning discarded wooden pallets into furniture).
- **Hence option (c) is the correct answer.**

Q 38.A

- **The waste management activities for both radioactive and chemical wastes generated from nuclear power plants and other nuclear fuel cycle facilities are in the purview of the Atomic Energy Regulatory Board (AERB). Hence statement 1 is correct.**
  - The waste management in industrial and research facilities of DAE also are under AERB's purview.
- **Radioactive wastes generated in the medical facilities using radioactive source for diagnostic and/or therapeutic applications also have to meet safety requirements stipulated by AERB. Hence statement 2 is not correct.**

- Waste management is reviewed across all stages: siting, construction, commissioning, operation, and decommissioning of Nuclear Power Plants (NPPs).
- Radiation dose to the public near NPPs is limited to 1 mSv/year (1000 micro-Sieverts), in line with International Commission on Radiological Protection (ICRP) standards.
- **AERB issues authorizations for waste disposal with a validity of three years.** Limits are specified for the quantity and activity of waste, and discharges must meet technical specifications set far below dose apportionment limits.
- India follows a closed fuel cycle, involving reprocessing and recycling spent fuel. 97-98% of spent fuel is recycled, with only 2-3% becoming high-level waste. High-level waste is eventually stored in geological disposal facilities.
- NPPs must submit a "return of waste disposed" to AERB. AERB reviews waste disposal practices during regulatory inspections. Environment Survey Labs (BARC) conduct independent surveys to assess environmental impacts.
- **Radioactive waste in India is covered by the following acts and rules**
    - **Atomic Energy Act, 1962 This act provides for the development, control, and use of atomic energy for the welfare of the people of India.**
    - **Atomic Energy (Safe Disposal of Radioactive Wastes) Rules, 1987 These rules govern the discharge of radioactive waste from nuclear power plants (NPPs). NPPs must obtain authorization from the Atomic Energy Regulatory Board (AERB) to dispose of radioactive waste.**
- **Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 (HWM Rules) do not cover radioactive wastes.**
- **Hence statement 3 is not correct.**

Q 39.B

- The Central Pollution Control Board of India (CPCB) **is a statutory organisation under the Ministry of Environment, Forest and Climate Change**. **It was established in 1974 under the Water Act, 1974.** The CPCB is **also entrusted with the powers and functions under the Air Act, 1981. Hence statement 1 is not correct.**
- The CPCB has wide-ranging powers and responsibilities like :
    - To advise the central government on any matter related to prevention and control of water and air pollution
    - Improvement of air quality
    - Plan nationwide programs for the prevention
    - Control and abatement of water and air pollution
    - **Coordinate the activities of SPCBs and resolve disputes among them. Hence statement 2 is correct.**

Q 40.D

- The CFLI was formed in 2019 by **Michael R. Bloomberg** in his role as **UN Special Envoy on Climate Ambition and Solutions**, at the request of the **United Nations Secretary-General, António Guterres**, to "support a global mobilization of **private finance** in response to the challenge of climate change." The CFLI convenes leading **private sector institutions** across the financial value chain, alongside policymakers and development finance institutions, to develop sector-specific financing and policy solutions in support of countries' climate goals. **Hence statement 1 is not correct.**
- **CFLI-India partnership** was launched jointly by **India and the United Kingdom** during their 11th economic and financial dialogue. CFLl India will be co-chaired by **Shemara Wikranamayake**, CEO of Macquarie Group and **Natarajan Chandrasekaran**, Chairman of Tata Group. CFLI India will be supported by **Bloomberg**, the **Global Infrastructure Facility**, UK Government, Government of India and **City of London Corporation.** Each party will contribute to this shared mission through their respective strengths and roles. CFLI India will focus on **private sector financing** of sustainable

infrastructure projects in specific low-carbon sectors to support India's ambition or meeting their **nationally determined contribution** (NDC). **Hence statement 2 is not correct.**

Q 41.D

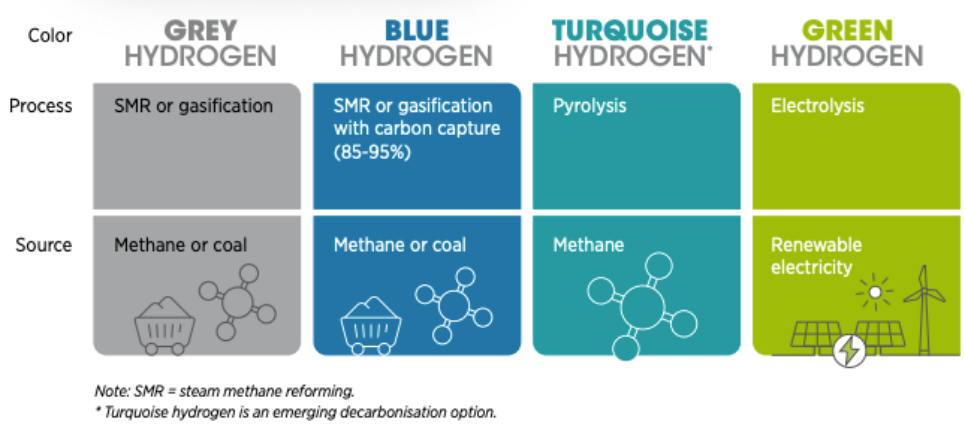
- A new report released by the Organisation for Economic Cooperation and Development (OECD) on November 16, 2023 stated that overall adaptation finance decreased by 14 per cent to $4 billion.
- In a statement released with the report, OECD also stated that the goal of developed countries providing $100 billion to developing countries may have been met in 2022 — but this was given without conclusive data to support it.
- **Key highlights from these reports include:**
- Mitigation finance continued to represent 60 per cent of total climate finance provided and mobilized in 2021, while adaptation comprised 27 per cent and cross-cutting 13 percent. **Hence statement 1 is not correct.**
- Climate finance from developed countries between 2016 and 2021 reached $73.1 billion. **However, loans continued dominating this component. Loans represented over two-thirds of the total, amounting to $49.6 billion, while grants were under 30 per cent at $20.1 billion, and equity investments remained marginal. Hence statement 2 is not correct**.
- A large part of the total $89.6 billion provided in 2020 comprised public climate finance (from both bilateral and multilateral sources). Between 2013 and 2021, this almost doubled from $38 billion to $73.1 billion.
- Loans represented over two-thirds of the total, amounting to $49.6 billion, while grants were under 30 per cent at $20.1 billion, and equity investments remained marginal. **The dominance of loans rather than more affordable sources of finance from developed countries has remained a contentious issue, particularly for low-income countries.**
- **Private climate finance mobilized amounted to $14.4 billion in 2021, constituting only 16 percent of the total finance. Hence statement 3 is not correct.**

Q 42.D

- **Biofuels** are **liquid fuels** produced from renewable biological sources, including **plants** and **algae.** Biofuels offer a solution to one of the challenges of solar, wind, and other alternative energy sources. Unlike other renewable energy sources, **biomass can be converted directly into liquid fuels**, called "biofuels," to help meet transportation fuel needs. **Hence statement 1 is correct.**
- The two most common types of biofuels in use today are **ethanol** and **biodiesel**, both of which represent the **first generation of biofuel technology**. Like petroleum-derived diesel, biodiesel is used to fuel compression-ignition (diesel) engines. **Biodiesel can be blended with petroleum diesel in any percentage**, including B100 (pure biodiesel) and, the most common blend, B20 (a blend containing 20% biodiesel and 80% petroleum diesel). **Hence statement 2 is correct.**
- Butanol, a 4-carbon alcohol (butyl alcohol), is produced from the same feedstocks as ethanol, including corn grain and other biomass. The term **biobutanol** refers to butanol made from biomass feedstocks. The benefits of biobutanol, when compared with ethanol, are that **biobutanol is immiscible in water**, has a **higher energy content**, and has a **lower Reid vapor pressure**. **Hence statement 3 is correct.**

Q 43.C

- **Grey hydrogen** is traditionally produced from methane (CH_4), split with steam into CO_2 – the main culprit for climate change – and H_2, hydrogen. Grey hydrogen has increasingly been produced also from coal, with significantly higher CO_2 emissions per unit of hydrogen produced, so much that is often called **brown or black hydrogen** instead of grey. **Hence statement 1 is correct.**
- **Turquoise hydrogen** is a type of hydrogen that is produced by splitting methane into hydrogen and solid carbon through a process called **methane pyrolysis**. It's considered a promising new technology that could help achieve carbon-free hydrogen. **Hence statement 2 is correct.**



- In a significant move for the progress of the **National Green Hydrogen Mission**, the government has notified the **Green Hydrogen Standard for India**. The standard issued by the **Ministry of New and Renewable Energy (MNRE)**, Government of India outlines the emission thresholds that must be met in order for hydrogen produced to be classified as 'Green', i.e., from renewable sources. The scope of the definition encompasses both electrolysis-based and biomass-based hydrogen production methods. After discussions with multiple stakeholders, the Ministry of New & Renewable Energy has decided to define **Green Hydrogen as having a well-to-gate emission (i.e., including water treatment, electrolysis, gas purification, drying and compression of hydrogen) of not more than 2 kg CO2 equivalent / kg H2.**

Q 44.B

- **Synthetic fuel** refers to fuels produced from **non-petroleum sources** through chemical processes, typically aiming to replicate the properties of conventional fossil fuels like gasoline, diesel, or jet fuel. Synthetic fuels offer several potential advantages, including **reduced greenhouse gas emissions** compared to traditional fossil fuels, enhanced energy security by diversifying fuel sources, and the potential to utilize existing infrastructure. **Hence statement 1 is correct.**
- Synthetic fuels can be derived from various **feedstocks**, including **biomass, coal, natural gas**, or even **captured carbon dioxide**. However, the production of synthetic fuels may also require significant energy input and infrastructure investment. Ongoing research and development in synthetic fuel technologies aim to improve efficiency, reduce costs, and advance their contribution to sustainable energy systems. **Hence statement 2 is correct.**
- Synthetic fuels, particularly those made from biomass or using carbon capture technologies, can have a lower carbon footprint than traditional fossil fuels.Synthetic fuels
  offer several potential advantages, including reduced greenhouse gas emissions compared to traditional fossil fuels, enhanced energy security by diversifying fuel sources, and the potential to utilize existing infrastructure. **Hence statement 3 not correct.**

Q 45.A

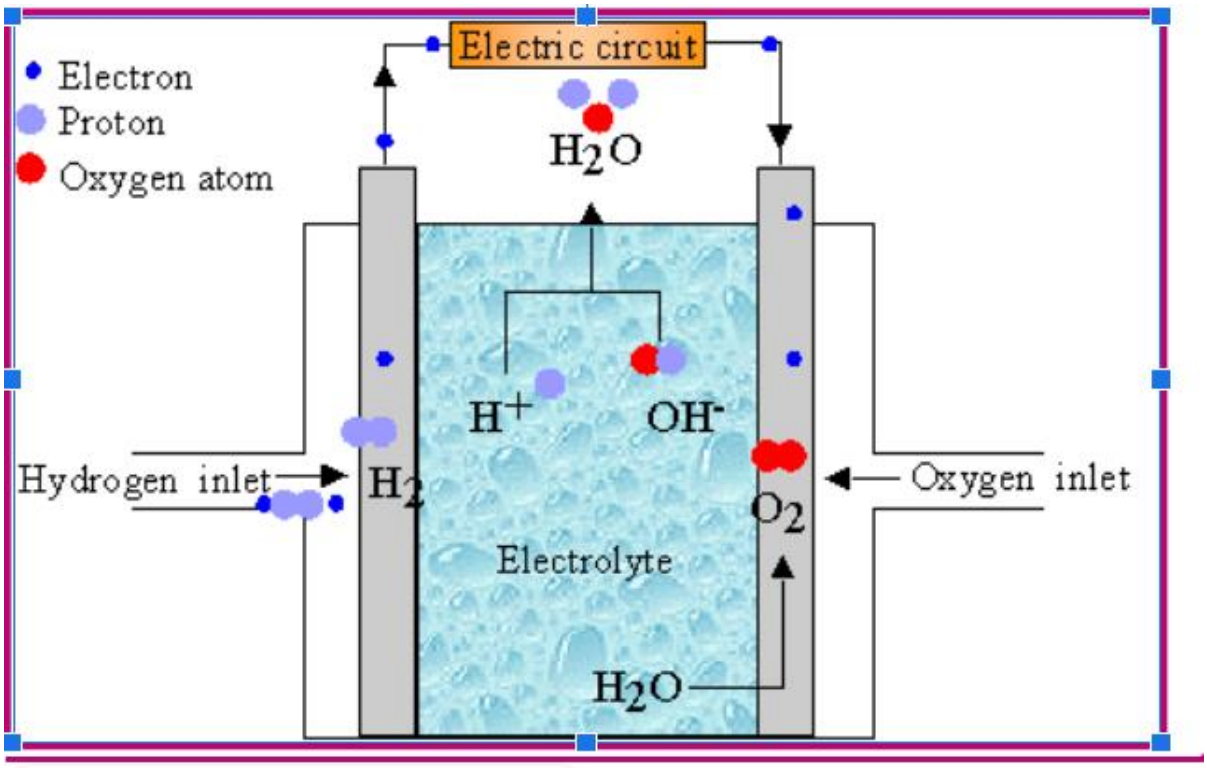
- **Ocean Thermal Energy Conversion (OTEC)** power generation uses temperature differences between the upper surface layer and deeper layers (800 –1000 m) of the sea, generally operating with temperature differences of around 20°C or more. The **OTEC technology is viable primarily in equatorial areas of the earth** where the year-round temperature differential between the deep cold and warm surface ocean waters is greater than 20 ºC (36 ºF). **Hence statement I is correct.**
- Energy from the sun heats the surface water of the ocean. **In tropical regions, surface water can be much warmer than deep water**. This temperature difference can be used to produce electricity and to desalinate ocean water. Ocean Thermal Energy Conversion (OTEC) systems use a temperature difference (of at least 20° Celsius or 36° Fahrenheit) to power a turbine to produce electricity. **Hence statement II is correct and statement II explains statement I.**
- **Hence option (a) is the correct answer.**

Q 46.C

- The **BICFIT (Baku Initiative for Climate Finance, Investment & Trade) Dialogue** was officially launched on the 14th of November 2024, during the first thematic day of COP29 in Azerbaijan, the inaugural Finance, Investment, and Trade Day. **Led by Azerbaijan's COP29 presidency**, BICFIT brings together finance, investment, and trade to respond to the urgent need for climate action as the window for impactful action narrows. **Hence statement 1 is correct.**
- The BICFIT initiative aims to strengthen and coordinate the response to climate challenges, fostering economic development and meaningful climate action. **BICFIT will encourage the creation of national, regional, and sub-regional platforms to enhance the climate finance, investment, and trade nexus. It will also support the design, structuring, and preparation of concrete, bankable climate projects, aligning climate action with development objectives at more targeted local levels**. To foster collaboration and shared solutions, regular BICFIT Dialogues will take place as part of the biannual UN Trade and Development (UNCTAD) World Investment Forum and other global platforms. **Hence statement 2 is correct.**
- The BICFIT initiative is led by the COP29 Presidency of Azerbaijan, co-facilitated by the **UN Trade and Development (UNCTAD)** and **UN Development Program (UNDP)**, in collaboration with other United Nations agencies and global partners, like the **World Trade Organization (WTO)** and the **International Trade Centre (ITC). Hence statement 3 is correct.**

Q 47.B

- Fuel cells represent the new generation of high-efficiency, environmentally friendly energy systems. **A fuel cell is a device in which electrical energy is generated by the electrochemical reaction between a fuel (H2 or a hydrocarbon) and an oxidant.** It differs from a battery in the fact that fuel is continuously supplied to the cell. **Hence statement 1 is correct.**
- Scientists and inventors have designed many different types and sizes of fuel cells in the search for greater efficiency, and the technical details of each kind vary. Many of the choices facing fuel cell developers are constrained by the choice of electrolyte. The design of electrodes, for example, and the materials used to make them depend on the electrolyte. **Today, the main electrolyte types are alkali, molten carbonate, phosphoric acid, proton exchange membrane (PEM) and solid oxide.** The first three are liquid electrolytes; the last two are solids. **Hence statement 2 is not correct.**
- Fuel cells have several benefits over conventional combustion-based technologies currently used in many power plants and vehicles. Fuel cells can operate at **higher efficiencies than combustion engines** and can convert the chemical energy in the fuel directly to electrical energy with efficiencies capable of exceeding 60%. **Fuel cells have lower or zero emissions compared to combustion engines**. Hydrogen fuel cells **emit only water**, addressing critical climate challenges as there are no carbon dioxide emissions. There also are **no air pollutants** that create smog and cause health problems at the point of operation. Fuel cells are **quiet during operation** as they have few moving parts. **Hence statement 3 is correct.**
- **Working of Fuel Cells:**
- Fuel cells work like batteries, but they do not run down or need recharging. They produce electricity and heat as long as fuel is supplied. A fuel cell consists of two electrodes—a negative electrode (or anode) and a positive electrode (or cathode)—sandwiched around an electrolyte. A fuel, such as hydrogen, is fed to the anode, and air is fed to the cathode. In a hydrogen fuel cell, a catalyst at the anode separates hydrogen molecules into protons and electrons, which take different paths to the cathode. The electrons go through an external circuit, creating a flow of electricity. The protons migrate through the electrolyte to the cathode, where they unite with oxygen and the electrons to produce water and heat.



Q 48.A

- Nonrenewable energy comes from sources that will run out or will not be replenished in our lifetimes—or even in many, many lifetimes.
- The most common nonrenewable energies are fossil fuels: coal, petroleum, and natural gas. **Carbon is the primary element in fossil fuels**.
- **Types of Non-Renewable Energy Sources**:
  - **Coal**: **A black or brownish rock, coal is a fossil fuel that is burned to provide energy. It was formed from the remains of plants fossil and is primarily used in electricity.** A major source of electricity and steel, coal is abundant but has a high environmental cost. **Hence statement 1 is correct.**
  - **The Petroleum is one of the liquid fossil fuels. It can also be simply called oil or crude oil**. The petroleum is in a part trapped by underground rock formations. An essential source for transport fuels (gasoline, diesel) as well as many industrial processes. Oil extraction and spills have serious environmental impacts. **Gasoline, diesel, and jet fuel are the products obtained from crude oil. Hence statement 2 is correct.**
  - **Natural Gas: Natural gas is a fossil fuel locked under the earth in reservoirs. It is composed mostly of methane. Main uses are generating electricity, heating purposes and as an industrial feedstock.** It burns cleaner than both coal and oil, but still emits greenhouse gases. **Hence statement 3 is not correct.**
- **Environmental Impact**:
  - **Greenhouse gas Emission**: The burning of fossil fuels releases carbon dioxide (CO2) along with other greenhouse gases, the byproduct of global warming and climate change.
  - **Pollution**: Nonrenewable resources extraction, processing and burning leads to air and water pollution, resulting in damaging of ecosystems as well as harming human health.
  - **Finite Resources**: These energy sources are limited and will eventually be exhausted, implying that they cannot be in use perpetually.
- **Hence option (a) is the correct answer.**

Q 49.A

- **Energy transition is the global energy sector's shift away from fossil fuels such as coal, natural gas, and oil to sources of renewable energy such as wind and solar energy.**
- The global energy sector would need to develop strategies for long-term energy transition, which create cleaner and sustainable options through an energy mix that reduces carbon emissions, and decarbonisation strategies.
- Despite the benefits of a renewable energy transition, achieving a truly global change requires support from governments, business and the public. Much of the push towards this transition comes from public opinion over climate change, yet many governments and businesses have been slow to engage with the transition in favour of continuing to reap profits from existing systems.
- Part of the problem also lies in investment and adoption of renewables by energy companies and electric utilities. In addition, much of the global workforce and many industries continue to depend on a fossil fuel economy, directly or indirectly.
- **Energy Diversification:** This refers to the strategy of spreading energy resources more evenly across different regions in order to reduce dependence on a single energy source or geographical area.
- **Decentralized Energy Systems:** This refers to the shift away from large, centralized power plants toward smaller, local energy sources that allow communities to generate and consume energy closer to the point of use.
- **Energy conversion** means converting raw energy (like from coal, gas, sunlight, or wind) into forms of energy which may be used by consumers like electricity, heat, or mechanical power.
- **Hence option (a) is the correct answer.**

Q 50.D

- **Hydropower, also known as hydroelectric power, is a process that generates electricity using the energy of flowing water. It is, therefore, one of the oldest and most widely used forms of renewable energy.** Hydropower plants utilize the kinetic energy of flowing water to turn a turbine which drives the mechanical energy into electrical energy using a generator.
- **Factors affecting Energy Levels Produced in a Hydropower Plant**:
  - **Water Flow Rate**: **The volume of water passing through the turbines per unit of time.** More flow rates means more water available to turn turbines, hence the more electricity produced.
  - **Head (Height of the Water Column)**: **The vertical distance the water falls. A higher head increases the potential energy of the water. The greater the height, the more energy that can be converted to electricity.**
  - **Turbine Efficiency**: The efficiency with which the turbine converts the kinetic energy of water into mechanical energy. More efficient turbines generate more electricity from the same amount of water.
  - **Generator Efficiency**: The efficiency with which mechanical energy extracted from a turbine is converted into electrical energy. The higher the efficiency, the less the energy lost in conversion.
  - **Flow Duration Curve**: A curve that demonstrates how flow rates are correlated with duration for which various flow rates occur. It aids in the planning of and optimizing the design and operation of the hydropower plant for sound energy output.
  - **Seasonal Variations**: **Changes in water flow resulting from seasonal patterns such as rainy seasons or snowmelt.** These changes affect the availability of water and, therefore, the amount of electricity that can be generated. Since plants with reservoirs can store water, this problem is minimized.
  - **Water density impacts the mass of water in a given volume. Although freshwater has a uniform density, the density of water changes with temperature: colder water is denser than warmer water. This, in turn, affects the amount of energy that can be produced because the more massive the water, the more energy can be generated.**
  - **Temperature affects various aspects of the hydroelectric plant, especially its turbine efficiency. Warmer water tends to have lower density, which can reduce the amount of potential energy for**

a given volume. In addition, temperature changes affect the viscosity of water, impacting the efficiency of turbines.
    - **Environmental Factors**: **Factors like sedimentation, quality of water, and health of aquatic ecosystems.** Such factors can influence the plant's operation and efficiency. Sedimentation, for instance, can reduce the reservoir's capacity and reduce turbine efficiency.
- **Hydropower Advantages**:
    - **Renewable**: Water is renewable.
    - **Reliability**: Can be a steady source of controllable electricity, especially in the case of reservoir and pumped-storage plants.
    - **Environmentally Friendly**: Is an emission-free technology source.
    - **Economic Benefits**: Low operating and maintenance costs once the infrastructure has been established.
- **Hydropower Disadvantages**:
    - **Environmental Impact**: Alters local ecosystems, fish populations, and water quality.
    - **High Initial Costs**: Extensive investment needed for building dams and other infrastructure.
    - **Geographical Constraints**: Sites are limited in geographical terms and remote from where power is required.
- **Hence option (d) is the correct answer.**

Q 51.A

- **Geothermal gradient is the rate of temperature change with respect to increasing depth in the Earth's crust.**
- **In degrees Celsius per kilometer, it is usually expressed in °C/km.**
- **Typical geothermal gradients average 25-30°C per kilometer**, but the gradients vary significantly within the earth depending on the geological conditions.
- **Variability**: **The geographical variation in the distribution of geothermal energy across the planet is known as geothermal energy distribution or geothermal resource distribution.**
    - **High Gradients**: Areas with active volcanic activity or tectonic movements have a high gradient.
    - **Low Gradients**: In stable, old continental crust areas, the gradient can be lower.
- **Applications**:
    - **Geothermal Energy**: Understanding the geothermal gradient is very important to identify potential locations for geothermal power plants.
    - **Oil and Gas Exploration**: Gradient helps in assessing the thermal maturity of potential hydrocarbon reservoirs.
    - **Scientific Research**: It helps understand the thermal history and dynamics of Earth's interior.
- **The rate at which geothermal energy can be extracted in a specific area is referred to as the geothermal power density or geothermal energy potential.**
- **Hence option (a) is the correct answer.**

Q 52.D

- **Wind energy represents a source of renewable energy,** which has gained increasingly wide-spread acceptance within the past few decades due in part to an increasing demand by people, businesses, and national governments for cleaner and more sustainable ways to provide their communities with energy.
- **Wind turbines are at the heart of this as they tap wind energy, so making it very crucial to make sure wind turbine efficiency is such that it can use all the available energy source. Some possible parameters that may influence wind turbine efficiency**:
    - **Wind speed and season**: **The prime source of energy, wind speed, and season, are powerful determiners of the performance and efficiency levels of wind turbines**. The wind speed at a given location will dictate the amount of wind energy that can be harvested by the wind turbine. This is because the wind speed impacts the amount of kinetic energy that can be captured by the wind turbine blades for transfer to the generator.

- **Air density and temperature**: Air density is the quantity of particles or mass within a selected volume of air, and this density impacts the air's mass flow rate through the wind turbine, which, in return, affects the power output.
  - **Air temperature has an impact on the efficiency of the wind turbine due to thermal expansion and contraction of materials attributed to the varying air temperatures.**
- **Height or elevation of the hub: Normally, with height, wind speed increases. Due to this, a higher wind turbine tower can harness more energy. This is the phenomenon of wind changing its speed with height, known as wind shear.**
- **Diameter of the rotating blades of the turbine**: Taller the diameter of the rotor of the wind turbine, the more area gets swept, thereby harnessing more wind, and subsequently generating much more electricity.
- **Pitch and yaw control**: Control strategies are the methods of controlling the blade pitch, rotor speed, generator torque, and yaw angle in a turbine. Optimization strategies represent the techniques to define the optimal values and settings of the control variables of the turbine as indicated by the objectives and constraints of the turbine system. For efficient performance of turbines, effective and adaptive control and optimization strategies need to be implemented. Optimized pitch and yaw control allow for the possibility of generating power at a wide wind speed range.
- **Turbine layout in the farm**: Turbines should be arranged in the wind farms in an optimized manner such that no turbine in the farm is placed in the wake of other turbines.
- **Reliability and maintenance**: Design of wind turbines with higher reliability rates influence the efficiency of the entire wind turbine system. However, in addition to design and the reliability of components, the ultimate success depends on users' adherence to reliable and effective maintenance practices to ensure maximum production and reduce energy losses in the operation of the wind turbines.
- **The type of material used for the turbine blades: The material used affects the durability and performance of the wind turbines.**

- **Hence option (d) is the correct answer.**

Q 53.D

- **India depends heavily on Coal as the major source of energy.**
- **As on 31.05.2023, energy generated capacity from Coal accounted for about 49.01% of the total installed capacity generation of energy followed by Solar (16.1%), Wind (10.3%), Natural Gas (6%), Lignite (1.6%), Small Hydropower(1.2%) , Diesel (0.1%).**

Installed GENERATION CAPACITY(FUELWISE) AS ON 31.05.2023		
CATAGORY	**INSTALLED GENERATION CAPACITY(MW)**	**% of SHARE IN Total**
Fossil Fuel		
Coal	205,235	**49.1%**
Lignite	6,620	1.6%
Gas	24,824	**6.0%**
Diesel	589	**0.1%**
Total Fossil Fuel	**2,37,269**	**56.8 %**
Non-Fossil Fuel		
RES (Incl. Hydro)	**173,619**	**41.4%**
Hydro	**46,850**	**11.2 %**
Wind, Solar & Other RE	125,692	30.2 %
Wind	42,868	10.3 %
Solar	67,078	16.1 %
BM Power/Cogen	10,248	2.5 %
Waste to Energy	554	0.1 %
Small Hydro Power	4,944	1.2 %
Nuclear	6,780	**1.6%**
Total Non-Fossil Fuel	**179,322**	43.0%
Total Installed Capacity (Fossil Fuel & Non-Fossil Fuel)	**4,17,668**	**100%**

- **Hence option (d) is the correct answer.**

Q 54.A

- **Renewable energy is energy derived from natural sources that are replenished at a higher rate than they are consumed. Renewable energy sources are plentiful and all around us**.
- For Example: Solar Energy, Wind Energy, Geothermal Energy, Hydro Power, Ocean Energy, Bio Energy.
- **Current Status of RE in India**:
  - **The share of RE in the total installed generation capacity in the country stands at approx 41.12% (Till 31.05.2023). Hence statement 1 is not correct.**
  - **India ranks fourth globally in renewable energy capacity. Hence statement 2 is correct.**
  - 4th in Wind Power (46.65 GW) capacity and 5th in solar photovoltaic power (85.47 GW).
  - **First time crossed 200 GW capacity from non-fossil fuel sources.**
  - It includes Solar power: 85.47 GW, Large hydro power: 46.93 GW, Wind power: 46.66 GW, Biopower: 10.95 GW, Small hydropower: 5.00 GW, Waste to Energy: 0.60 GW.
- Renewable energy targets in India:
  - **India aims reaching a non-fossil fuel energy capacity of 500 GW by 2030. Hence statement 3 is not correct.**
  - Fulfilling at least half of its energy requirements via Renewable energy by 2030.

Q 55.C

- The **Environment Impact Assessment** evaluates the likely environmental impacts of a proposed project or development. This assessment also takes into account human health and socioeconomic impact on the community living in the proposed project area. In 2022, The Ministry of Environment, Forests and Climate Change notified an amendment to the Environment Impact Assessment (EIA) Rules.
- Amended EIA rules exempt **Highway projects of strategic and defense importance, which are 100 km from the Line of Control**, among other locations, from an environmental clearance before construction. **Hence option 1 is correct.**
- **Thermal power plants up to 15 MW based on biomass** or **non-hazardous municipal solid waste using auxiliary fuel** such as coal, lignite, or petroleum products up to 15 percent have also been exempted — as long as the fuel mix is eco-friendly, according to the 2022 notification. **Hence option 2 is not correct.**
- Taking into account issues of livelihood security of fishermen involved at **fish handling ports** and **harbors**, and the less pollution potential of these ports and harbors compared to others, increasing the threshold of ports which exclusively deal in fish handling, and caters to small fishermen, will be exempted from environmental clearance, under new EIA rules. **Hence option 3 is correct.**
- Toll plazas that need more width for installation of toll collection booths to cater to a large number of vehicles, and **expansion activities in existing airports** related to terminal building expansion without increase in the airport's existing area, rather than expansion of runways, etc., are two other projects exempted. **Hence option 4 is correct.**
- **Hence option (c) is the correct answer.**

Q 56.B

- **Sun is the major source of energy. Sunlight is a clean and renewable source of energy. It is sustainable, so it will never run out because the sun shines almost daily.** It is called 'Green Power'.
- **Advantages**:
  - **It is a free, natural, and perennial source.**
  - **It is widely accessible.**
  - It doesn't pollute the environment.
  - There are no greenhouse gasses released by it.
  - In the majority of (sunny) places, solar energy provides decentralization, resulting in independent communities.
  - Avoiding the politics and price instability that increasingly define fossil fuel markets is one of the main benefits of solar energy.
  - Unlike most fossil fuel activities, it does not lead to the loss of forests and eco-systems.
- **Disadvantages**:
  - **Depending on weather and seasonal variations, they could not always be utilized. Hence option 2 is not correct.**
  - **High upfront costs are necessary for effective use. Hence option 1 is correct.**
  - Although solar systems don't operate directly at night, they can be used at night thanks to battery banks that store energy throughout the day.
  - No development in storage technology has been done in solar electric yet.
  - **The solar panels are bulky. This is particularly true of the higher-efficiency, traditional silicon crystalline wafer solar modules. Hence option 3 is correct.**

Q 57.C

- **Biomass is organic matter similar to fossil fuels (coal, oil, or natural gas), except that fossil fuels were created in the earth from plant and/or animal remains over millions of years while biomass on the other hand is much more recently created and is renewable on a much smaller time scale as plants grow continuously, animals constantly produce manure, and people throw away waste material every day.**

- Secondly, **Bio-materials as a source of fuel have no scarcity since they are always under growth**. Thus, bio-materials would be considered as an alternative renewable source of energy.
- **Biomass comes in all three categories of matter states: Solid, Liquid, and Gas.**
- **Solids – also referred to as "feedstock," which are solid or compacted bits of organic matter in the form of pellets that have their stored energy released through combustion and burning. Solid biomass or feedstock materials include**:
  - **Wood & wood residues** such as trees, shrubs, sawdust, pellets, chips and waste wood.
  - **Agricultural residues like straw, grasses, seeds, roots, dried plants, nut shells and husks**.
  - Energy crops from charcoal, peat leaf litter, and moss.
  - Processed waste such as Bagasse plant waste.
  - **Animal waste such as dried slurry and manure.**
  - Municipal solid waste from household rubbish and garbage. **Hence options 1, 2 and 3 are correct.**
- **Liquids – also known as "biofuel", is any kind of fluid or liquid produced from solid matter that is still growing or has been alive at some point which can be processed to produce a type of fuel. Liquid biomass or biofuel fluids include**:
  - Pure Vegetable oils from sunflower and rapeseed, or recycled waste vegetable oils.
  - Methanol, Ethanol and alcohol based fuels fermented from corn, grain and other plant matter.
  - Biodiesel distilled from vegetable oils and animal fats.
  - P-Series fuels, which blend various solid and liquid matters together to produce a fuel.
- **Gases – also known as "biogas", is any kind of natural forming gas given off by decaying plants, rotting rubbish, decomposing animals, slurry and manure that can be used as a type of fuel. Liquid biomass or biogas include**:
  - Methane from decomposing plants, animals and manure.
  - Biogases generated from rotting rubbish in landfills.
  - Hydrogen for batteries and fuel cells.
  - **Synthesis Gas blended from Carbon Monoxide and Hydrogen.**
  - **Natural Gas from fossil fuels.**
- **Hence option (c) is the correct answer.**

Q 58.A

- **Climate Neutral Now Initiative**
  - **Launched by UNFCCC:** Started in 2015 to encourage climate action by involving non-party stakeholders (governments, businesses, organizations, individuals). **Hence option (a) is the correct answer.**
  - **Objective:** Promotes voluntary use of carbon market mechanisms recognized under the Convention.
  - **Purpose:** Aim to raise awareness, build capacity, foster partnerships, and facilitate carbon footprint estimation, reduction, and voluntary offsetting.
  - **Three-Step Process for Climate Neutrality:**
    - **Measure Climate Footprint:** Assess the total greenhouse gases produced by activities and operations.
    - **Reduce Emissions:** Implement practices like energy efficiency, sustainable methods, and renewable energy adoption to lower emissions.
    - **Offset Unavoidable Emissions:** Purchase UN-certified emission reductions to balance remaining emissions through verified projects that reduce or remove emissions.

Q 59.A

- **Recent Context: Kazan Declaration adopted by BRICS rejected CBAM, calling it discriminatory.**
- To reach its climate goal, the **European Union has come up with an ambitious package of legislation known as Fit for 55 in 2030. It comprises several interlinked revised laws and new proposed laws on climate and energy. carbon border adjustment mechanism (CBAM) is European Union's (EU) policy to impose a carbon tax on imports of certain products from countries with less stringent climate policies**. E.g. Steel. Carbon Border Tax aims to prevent companies from shifting production to

less-regulated countries. CBAM, implemented in 2023, moves from a transitional phase to full enforcement by 2026. **Hence statement 1 is correct.**

- The obligations imposed by the CBAM apply to all who import CBAM goods, where the total intrinsic value of the CBAM goods within the consignment exceeds a value of €150. Imports mean any imports to the EU from outside the EU, including e.g., imports of goods ordered online and imports of gifts. **Hence statement 2 is not correct.**
- CBAM was proposed by the European Commission in July 2021 as part of the EU's "Fit for 55 in 2030 package. The Carbon Border Adjustment Mechanism (CBAM) was implemented by the EU in 2023, not 2015. **Hence statement 3 is not correct.**

Q 60.D

- **Direct Air Capture** is a technological process that extracts CO2 directly from the ambient air and either stores it underground or utilizes it in products like synthetic fuels or chemicals. **Hence option 1 is correct.**
- **Ocean iron fertilization** is the process through which the soluble iron salts or ferrous dust are added to surface waters where it is currently lacking, for example in mid-ocean gyres and the Southern Ocean. This should increase primary production and boost the ocean carbon pump in these ocean regions. **Hence option 2 is correct.**
- **Soil carbon sequestration**, also known as “carbon farming” or “regenerative agriculture,” includes various ways of managing land, especially farmland, so that soils absorb and hold more carbon. **Hence option 3 is correct.**
- **Ocean Alkalinity Enhancement increases the ocean’s ability to absorb CO2** by adding alkaline substances to seawater, thereby increasing the ocean's carbon storage capacity.
- The increased alkalinity leads to more CO2 being converted into bicarbonate ions, which are stable and can be stored in the ocean for long periods. **Hence option 4 is correct.**

Q 61.D

- The Kigali Amendment is an amendment to the Montreal Protocol, an international agreement to protect the ozone layer. The Kigali Amendment aims to reduce HFC production and consumption by 80–85% by 2047. **Hence statement 1 is not correct.**
- **Ozone-depleting substances (ODS) are chemicals that cause the depletion of the stratospheric ozone layer. This layer is crucial for protecting life on Earth by absorbing the majority of the sun's harmful ultraviolet (UV) radiation.**
- **The most common ODS include chlorofluorocarbons (CFCs), halons, carbon tetrachloride, and methyl chloroform.**
- HFCs are commonly used alternatives to Ozone Depleting Substance such as hydrochlorofluorocarbons (HCFCs) and chlorofluorocarbons (CFCs), which are already controlled under the Montreal Protocol. **Hence statement 2 is not correct.**

Q 62.D

- **Commission for Air Quality Management (CAQM)**
  - **Context:** The Supreme Court pulled up the Commission for Air Quality Management (CAQM), the government’s monitoring agency, on its inadequate pollution control response.
  - The Commission was first formed by an ordinance in October 2020.
  - The erstwhile Environment Pollution (Prevention and Control) Authority, or EPCA had been dissolved to make way for the Commission.
  - The Commission will be a statutory authority.
  - The Commission will supersede bodies such as the central and state pollution control boards of Delhi, Punjab, Haryana, UP, and Rajasthan.
  - In 2021, the Parliament approved the Commission for Air Quality Management in the National Capital Region and Adjoining Areas Bill.

- **Composition:**
  - Chairperson: To be chaired by a government official of the rank of Secretary or Chief Secretary. **Hence option (d) is the correct answer.**
  - The chairperson will hold the post for three years or until s/he attains the age of 70 years.
  - It will have members from several Ministries and representatives from the stakeholder States.
  - It will have experts from the Central Pollution Control Board (CPCB), Indian Space Research Organisation (ISRO) and Civil Society.
- **About Graded Response Action Plan (GRAP):**
  - GRAP is a framework to address air pollution in the Delhi-NCR region.
  - It is an emergency response mechanism triggered when the Air Quality Index (AQI) reaches "poor" levels.
  - GRAP is especially crucial during winter when air quality worsens significantly.
- **Who Implements GRAP?**
  - The Commission for Air Quality Management (CAQM) oversees GRAP implementation in NCR and adjoining areas.
  - It collaborates with the Ministry of Environment, Forest and Climate Change (MoEFCC).
  - A sub-committee has been constituted by the CAQM to operationalize GRAP.
- **Sub-Committee Composition:**
  - Officials from the CAQM.
  - Member secretaries of pollution control boards of Delhi, Uttar Pradesh, Haryana, and Rajasthan.
  - Representatives from the Central Pollution Control Board (CPCB).
  - Scientists from the Indian Meteorological Department (IMD) and IITM.
  - A Health Advisor.
- **Sub-Committee Responsibilities:**
  - Meets frequently to issue directives for invoking GRAP.
  - CAQM orders take precedence over state government directives in case of conflicts.

Q 63.D

- Climate forcing, also known as radiative forcing, is the imbalance in the Earth's energy budget that results from changes to the climate system. This imbalance can be caused by natural or human-induced changes, such as changes in atmospheric composition, solar radiation, or volcanic eruptions.
- Climate forcings can be positive or negative. Positive forcings, such as those caused by greenhouse gases, cause the Earth to warm. Negative forcings, such as those caused by volcanic eruptions, cause the Earth to cool.
- Anthropogenic sources of greenhouse gases, such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), are the dominant positive climate forcing.
- Solar irradiance is the amount of solar energy that reaches the Earth's surface per unit of area, measured in watts per square meter (W/m^2). It's a measure of the instantaneous intensity of the sun's light. Solar irradiance over recent decades has contributed a relatively small positive radiative forcing of approximately +0.05 W/m^2 since 1750 according to the IPCC. **Hence statement 1 is not correct.**
- Albedo is a measure of how much sunlight is reflected away from the Earth. Ice has a high albedo, meaning it reflects more sunlight than land or water. When polar ice melts, the Earth's surface becomes less reflective, absorbing more solar radiation. This is known as the ice-albedo feedback loop.
- Decreased polar ice albedo is an example of positive climate forcing since it leads to more absorption of sunlight, enhancing global warming. **Hence statement 2 is not correct.**

Q 64.D

- **Recent context: Climate Change Performance Index (CCPI) 2025 is released by think tanks Germanwatch, New Climate Institute, and Climate Action Network International.**
- **Climate Change Performance Index (CCPI)**

- **Context:** India drops two places but remains among the top 10 climate performers. **Hence statement 1 is not correct.**
- **Publishers:** Germanwatch, New Climate Institute, and Climate Action Network International. **Hence statement 2 is not correct.**
- **Purpose:** Tracks the progress of the world's largest emitters on emissions, renewable energy, and climate policies. **Hence statement 3 is not correct.**
- **First Published:** 2005.
- **Key Highlights:**
  - **India's Rank:** 10th among over 60 countries assessed for climate change efforts.
  - **Scope of Assessment:** The 63 countries plus the EU together contribute 90% of global emissions.
- **India's Progress:**
  - Significant advancements in renewable energy policy, notably through large-scale solar power and the Rooftop Solar Scheme.
  - Initiated energy efficiency standards, though coverage is limited.
  - Growth in electric vehicle adoption, particularly two-wheelers.
- **Global Context:**
  - Denmark leads (technically fourth place), followed by the Netherlands and the UK.
  - The UK saw major improvements due to its coal phase-out and a commitment to halt new fossil fuel licenses.
- **High Performers:** India and the UK are the only G20 countries listed as high performers.

Q 65.C

- Global Warming Potential (GWP) quantifies the heat trapped by a specific greenhouse gas relative to carbon dioxide (CO2), which is assigned a GWP value of 1.
- The GWP of nitrous oxide over 100 years is about 298. This means that, over a 100-year period, one ton of nitrous oxide has the same warming effect. Carbon dioxide's (CO2) atmospheric lifetime is difficult to define because it moves between different reservoirs in the Earth's system at different rates. However, a commonly used estimate is 100 years. **Hence statement I is correct.**
- **Nitrous oxide is a more potent greenhouse gas because its molecules are more effective at absorbing and trapping heat in the atmosphere compared to CO2.**
- **N2O has a relatively long atmospheric lifetime (around 114 years), which allows it to have a sustained warming effect.**
- The sustained warming effect makes N2O particularly potent as a greenhouse gas, as it continues to influence the Earth's energy balance for an extended period, contributing to global temperature rise and climate change over the long term. **Hence statement II is not correct.**
- **Hence option (c) is the correct answer.**

Q 66.B

- Conservation agriculture and organic farming both maintain a balance between agriculture and resources, use crop rotation, and protect the soil's organic matter.
- However, the main difference between these two types of farming is that **organic farmers use a plow or soil tillage,** while **farmers who practice conservation agriculture use natural principles and do not till the soil. Hence option (b) is the correct answer.**
- Organic farmers apply tillage to remove weeds without using inorganic fertilizers.
- Conservation agriculture farmers, on the other hand, use a permanent soil cover and plant seeds through this layer.
- They may initially use inorganic fertilizers to manage weeds, especially in soils with low fertility.
- Over time, the use of agrichemicals may be reduced or slowly phased out.

Q 67.B

- **Context:** Recently, in response to the pressing threat of climate change, the New Collective Quantified Goal on Climate Finance (NCQG) has emerged as a crucial initiative to mobilize resources for developing countries to combat climate challenges.
- **What is the New Collective Quantified Goal on Climate Finance (NCQG)?**
  - NCQG is a new annual climate finance target for developed countries starting in 2025. **Hence statement 1 is not correct.**
  - It replaces the earlier commitment of USD 100 billion per year, pledged in 2009 but not fully delivered. **Hence statement 2 is correct.**
- **Key Objectives:**
  - **Empowering Developing Countries: It p**rovides financial resources to nations that are highly affected by climate change despite minimal contributions to emissions. It supports investments in clean energy, climate adaptation, and resilient infrastructure.
  - **Accelerating Climate Action:** Facilitates funding for ambitious mitigation and adaptation initiatives aligned with the Paris Agreement.
  - **Promoting a Just Transition:** Enables a shift to low-carbon economies, creating jobs and protecting vulnerable communities.
  - **Enhancing Global Cooperation:** Encourages collaboration between developed and developing nations to strengthen the global climate response.

Q 68.A

- The **Central Electricity Regulatory Commission (CERC)** introduced the technology multiplier in the REC Regulations 2022 to encourage the adoption of new and more expensive renewable energy technologies.
- A higher multiplier means that a producer receives more RECs for the same amount of electricity they produce. For example, a multiplier of 1 means one REC is issued for each MWh of electricity, while a multiplier of 2 means two RECs are issued for each MWh.
- The revenue multiplier in the REC mechanism depends on regulatory frameworks and specific project characteristics. While wind and solar projects technology multipliers of 1, biomass or biofuel based renewable energy projects qualify for higher multipliers i.e 2. **Hence statement 1 is not correct.**
- **A Renewable Energy Certificate (REC) remains valid until it is redeemed.** This was changed in 2022 by the Central Electricity Regulatory Commission (CERC) as part of the Terms and Conditions for Renewable Energy Certificates in Renewable Energy Generation Regulations. **Hence statement 2 is not correct.**
- **Any entities generating renewable energy are required to apply for RECs within six months of the generation, as stipulated in the REC regulations, to maintain accuracy in tracking and promoting renewable energy contributions. Hence statement 3 is correct.**

Q 69.B

- **The Global River Cities Alliance (GRCA) is a unique alliance covering 275+ global river-cities in 11 countries, international funding agencies and knowledge management partners and is first of its kind in the world.**
- The Global River Cities Alliance (GRCA), led by the National Mission for Clean Ganga (NMCG) under the Ministry of Jal Shakti, Government of India, was launched at COP28, the United Nations Climate Change Conference in Dubai. **Hence statement 1 is not correct.**
- It was launched by India along with UAE , Egypt, Netherlands, Denmark, Ghana, Australia, Bhutan, Cambodia, Japan and river-cities of The Hague (Den Haag) from the Netherlands, Adelaide from Australia, and Szolnok of Hungary and International funding agencies the World Bank, Asian Development Bank (ADB), Asian Infrastructure Investment Bank (AIIB). **Hence statement 2 is correct.**
- **Significances of GRCA**
  - Making river basin cities water-sensitive for improved river health.

- Strengthen governance of river cities and improve their liveability to attract external economic investments.
- Promotes Urban River Management Plans and city-specific sectoral strategies for sustainable urban river management.
- Support member cities in implementation of SDG6-Clean Water and Sanitation.

Q 70.B

- The Alliance for Transformative Action on Climate and Health (ATACH; "the Alliance") works to realize the ambition set at COP26 to build climate resilient and sustainable health systems, using the collective power of WHO Member States ("Member States") and other stakeholders to drive this agenda forward at pace and scale; and promote the integration of climate change and health nexus into respective national, regional, and global plans. **Hence statement 1 is correct.**
- ATACH welcomes the participation and support from key stakeholders including government entities, intergovernmental entities, and non-State actors to assist WHO in supporting Member States through knowledge sharing, technical support, capacity development and resource mobilization. **Hence statement 2 is correct.**
- ATACH is a WHO initiative, an informal voluntary network for Participants to exchange views, share information, and enhance technical and political co-operation. It is not a distinct legal entity, and it derives its legal status from WHO. Thus, it shall be administered by WHO, which provides its Secretariat. **Hence statement 3 is not correct.**

Q 71.A

- **Recent Context:** India adds five more wetlands to its list of Ramsar sites.
- With the addition of these five wetlands to List of Wetlands of International Importance, the total area covered under Ramsar sites is now 1.33 million hectares.
- **The newly declared sites include Karaivetti Bird Sanctuary and Longwood Shola Reserve Forest in Tamil Nadu, and Magadi Kere Conservation Reserve, Ankasamudra Bird Conservation Reserve and Aghanashini Estuary in Karnataka.**
- **The Karaivetti Birds Sanctuary in Tamil Nadu** spans over 453 hectares and "is one of the most important fresh water feeding grounds for migratory water birds in the state of Tamil Nadu," hosting over 188 bird species, of which 82 are water birds. Apart from water birds, the sanctuary is also an important nesting site for threatened species like the spotted eagle and the tawny eagle.
- **The Longwood Shola** is a high-altitude wetland that acts as a water source for 18 villages downstream and is also considered an Important Bird Area (IBA), hosting several endemic bird species. The Longwood Shola is recognised and protected as a Reserve Forest.
- Of the newly declared sites in Karnataka, **Aghanashini Estuary** is the largest at 4801 hectares. The mangroves along the Aghanashini river act as a nursery for fishes and prawns and are considered as important fish breeding and spawning areas. Several species of fish visit nutrient rich mangrove area for laying eggs so that the juveniles grow amidst abundance of food before they leave for the sea.
- The other two sites, **Magadi Kere and Ankasamudra Reserve**, **are both artificial tanks.** The former is one of the largest wintering grounds for bar-headed goose in southern India and the latter is home to 210 species of plants, 8 species of mammals, 25 species of reptiles, 240 species of birds and 41 species of fishes, apart from frogs, butterflies and other insects.

Q 72.D

- The price of carbon credits is determined by market forces in trading systems such as the European Union Emission Trading System (EU ETS) or voluntary carbon markets. The World Bank supports carbon pricing initiatives but does not directly set prices. **Hence statement 1 is not correct.**
- Carbon credits are not traded on the Multi Commodity Exchange (MCX) in India. Instead, they are traded in international markets or through bilateral agreements. **Hence statement 2 is not correct.**

- The Carbon Credit Trading Scheme (CCTS) is a domestic carbon market that allows designated agencies to issue carbon credit certificates (CCCs). Each CCC represents one tonne of CO2 equivalent (tCO2e) reduction or removal from the atmosphere. The Ministry of Power (MoP) oversees the CCTS, and the Bureau of Energy Efficiency (BEE) is the designated administrator.

Q 73.B

- **Recent Context:** The International Energy Agency's Global Methane Tracker 2024 indicates that methane emissions from fuel usage in 2023 were nearly at their highest level on record, representing a slight increase compared to 2022.
- **Global Methane Tracker is a tool developed by the International Energy Agency (IEA) to track global methane emissions**. The IEA tracks methane emissions from various sectors like oil and gas, coal mining, and agriculture to help identify opportunities for reducing these emissions and mitigate climate change. **Hence statement 1 is not correct.**
- Wetlands are the largest source of methane emission.Wetlands, such as marshes, swamps, and bogs, are often saturated with water, creating anaerobic conditions (lack of oxygen) that promote the activity of methanogenic bacteria. **Hence statement 2 is correct.**
- When plant material and other organic matter in the wetland decay, methanogens break it down into methane and carbon dioxide. This is particularly prominent in areas where there is abundant plant growth and organic material accumulation.
- The Oil & Gas Methane Partnership 2.0 (OGMP 2.0) is the flagship oil and gas reporting and mitigation programme of the United Nations Environment Programme (UNEP). It is the only comprehensive, measurement-based international reporting framework for the sector. **Hence statement 3 is correct.**

Q 74.B

- **Recent Context: World Meteorological Organisation (WMO) released 2nd Edition of WMO Ozone and UV Bulletin.**
- The ozone hole is a region where ozone levels drop below 200 Dobson Units. It's caused by ozone-depleting substances like chlorofluorocarbons (CFCs) and related chemicals. These chemicals were once widely used in refrigerators, air conditioners, and spray cans. The Antarctic ozone hole is a seasonal thinning of the ozone layer over the Antarctic that occurs each spring.
- **The Antarctic ozone hole has shown signs of recovery over the past two decades** due to global efforts under the Montreal Protocol, which phased out ozone-depleting substances (ODS) like chlorofluorocarbons (CFCs). While there are year-to-year variations, **the overall trend is a gradual reduction in the size and depth of the ozone hole.** According to WMO Ozone and UV Bulletin, the ozone layer is recovering, with ozone-depleting substances (ODS) decreasing. Full recovery to 1980 levels is expected by 2066 over Antarctica; by 2045 over the Arctic and by 2040 for the rest of the world. **Hence statement 1 is not correct.**
- **A strong and stable polar vortex isolates cold air over Antarctica, creating the conditions for the formation of polar stratospheric clouds (PSCs).** These clouds facilitate the chemical reactions that release chlorine and bromine from ozone-depleting compounds, **leading to ozone destruction and an increase in the size and depth of the ozone hole. Hence statement 2 is correct.**

Q 75.B

- **Recent context: The Asia-Pacific Climate Report 2024, released by the Asian Development Bank (ADB)**, paints a concerning picture of the region's vulnerability to climate change and the potential economic consequences.
- Key Highlights of the Asia-Pacific Climate Report
  - As per the report, Under high-end greenhouse gas emissions, the APAC region could see a 17% reduction in Gross Domestic Product (GDP) by 2070. By 2100, this figure may surge to 41% under high GHG emissions.

- India could face a 24.7 percent loss in GDP by 2070, with neighbouring countries like Bangladesh (minus 30.5 percent), Vietnam (minus 30.2 percent), and Indonesia (minus 26.8 percent) seeing even steeper declines.
- Cooling demands may reduce regional GDP by 3.3 per cent, but for India, this figure could reach 5.1 per cent. River flooding also threatens to shrink India's GDP by around 4 per cent, underscoring its heightened vulnerability to climate impact.
- Up to 300 million people are at risk of coastal flooding due to sea level rise by 2070. Annual damages could climb to USD 3 trillion by 2070.
- The APAC region is expected to suffer a 4.9% GDP loss due to reduced labour productivity, but India's loss could be as high as 11.6%.

- **Hence option (b) is the correct answer.**

Q 76.B

- **Recent Context:** The COP29 of UNFCCC held in **Baku, t**he capital and largest city of Azerbaijan, as well as the largest city on the Caspian Sea and in the Caucasus regionr, recently marked the **adoption of Article 6 of the Paris Agreement after nine years of negotiations.**
- **Article 6 enables countries to cooperate in implementing their Nationally Determined Contributions (NDCs) through carbon markets and mitigation measures.**
- **Hence option (b) is the correct answer.**

Q 77.B

- **Recent Context:** Researchers at the Indian Institute of Science (IISc) in Bengaluru have developed an innovative, eco-friendly bio-derived foam recently.
  - This bio-derived foam provides a sustainable alternative to plastic materials commonly used in traditional FMCG packaging.
  - **Composition:** Made from bio-based epoxy resins derived from non-edible oils approved by the US FDA, combined with hardeners extracted from tea leaves. **Hence option (b) is the correct answer.**
  - **Purpose:** Serves as an eco-friendly substitute for conventional expanded polystyrene (EPS) and polyurethane (PU) foams.
  - **Environmental Benefits:**
    > Disintegrates in landfills without contaminating groundwater, offering a greener solution compared to traditional plastic foams.
    > Can break down within 3 hours when exposed to eco-friendly solvents at 80°C.
  - **Recyclability:** Contains chemical bonds that can be broken and reformed in response to external stimuli, enabling mechanical reprocessing or dissolution in eco-friendly solvents.
  - **Applications:** Provides sustainable packaging solutions, helping industries adopt environmentally responsible practices.

Q 78.C

- **Recent Context:** A recent research paper explores the presence of some virus species in wild bee and hoverfly species across different landscapes in Switzerland.
  - **Virus in Bees:** A recent study detected the presence of deformed wing virus and black queen cell virus in 19 wild bee and hoverfly species across various landscapes in Switzerland.
  - **Findings:**
    > Higher pathogen loads were observed in wild pollinators accessing the same floral resources as honey bees.
    > Pathogen loads among wild pollinators in shared habitats were 10 times higher.
  - **Causes:**
    > **Pathogen Spillover: Pathogen spread or 'spillover' can occur when heavily infected, domestic hosts interact with closely-related wildlife populations.** The managed of commercial western honey bees, often acting as viral reservoirs, transmit pathogens to wild pollinators when they share habitats. **Hence statement 1 is correct.**

- > **Pathogen Spillback:** Pathogen Spillback occurs when wild pollinators, after being infected by a pathogen, transmit it back to managed honey bee populations. The pathogen may be less virulent or adapt differently in the wild hosts. **Hence statement 2 is correct.**
- **Impact of Habitat Loss:**
  - > Habitat fragmentation forces pollinators into smaller areas, increasing competition for resources and risk of disease transmission.
  - > Projections indicate that by 2050, 40% of bumblebee species in the Indian Himalayas could lose over 90% of their habitat, heightening competition with western honey bees.
- **Control Measures:**
  - > Creating diverse, pollinator-friendly habitats with abundant floral resources reduces the risk of pathogen spillover and spillback.
  - > Enhanced research and surveillance are essential to monitor and address emerging diseases in bees and other pollinators.

Q 79.A

- **Mealworm Larvae**
  - **Context:** Researchers at the International Centre of Insect Physiology and Ecology in Kenya have discovered that the Kenyan lesser mealworm larvae can degrade polystyrene plastic, offering a potential solution to plastic pollution. **Hence statement 1 is correct.**
  - **About Mealworm Larvae:**
    - > **Mealworms are the larval stage of the Tenebrio molitor beetle, commonly found in grain storage and as a source of food for reptiles, birds, and humans. They have gained attention in environmental science, particularly for their ability to degrade plastics. They are commercially available in bulk and are typically available in containers with bran or oatmeal for food.**
    - > Mealworms are edible for humans, and processed into several insect food items available in food retail such as insect burgers
    - > **Species:** The Kenyan lesser mealworm is the larval form of the Alphitobius darkling beetle.
    - > **Habitat:** Found in poultry rearing houses; thrives in warm, food-rich environments.
    - > **Plastic Consumption:** Capable of degrading polystyrene with assistance from gut bacteria like Proteobacteria and Firmicutes.
    - > **Significance:** Shows potential for scalable solutions to plastic degradation without direct release of insects into the environment.
  - **Lesser mealworms are not native to the Western Ghats**. They are found worldwide and are commonly associated with poultry farms and stored grain products. Their distribution is not specific to the Western Ghats. **These are native to Mediterranean region. Hence Statement 2 is not correct.**
  - **Plastic-Decomposing Insects:**
  - **Yellow Mealworms (Tenebrio molitor):** Break down polystyrene with gut bacteria.
    - > **Superworms (Zophobas morio):** Known to digest synthetic plastics like polystyrene.
    - > **Kenyan Lesser Mealworm:** The first African-native species identified to degrade polystyrene.

Q 80.A

- **Recent Context:** People in Geelong city, Australia have beelined to witness an unusual event, the blooming of the Amorphophallus Titanum.
- **Amorphophallus Titanum (called Titan Arum in short) is a rare species, that blooms once in a decade**. It is also called the 'corpse flower'. **Hence option (a) is the correct answer.**
  - **Size:** It is one of the largest in the world, growing over 10 ft. in height.
  - **Native:** It is native to western Sumatra, Indonesia.
  - **Fragrance:**

- The flower smells like putrid dead bodies, only releasing this smell for 24-48 hours.
- It mimics the stench of rotting flesh to attract pollinators, carnivorous bees and flies that feed on corpses.

- **Features:** The massive inflorescence of the titan arum consists of an inner flower spike, known as a spadix, surrounded by a petal-like collar known as
- **Habitat:**
  - It blossoms on limestone hills in the rainforests of western Sumatra, Indonesia, where it is called bunga bangkai (bunga means flower and bangkai means corpse).
  - Titan Arum doesn't bloom in the wild in Australia.
- **Conservation status**
  - **IUCN:** Endangered
- **Other similar species**
  - **Rafflesia Arnoldi:** The largest individual flower in the world.
  - **Dracunculus vulgaris, Stapelia gigantea, Hydnora africana and Helicodiceros muscivorus,** as well as varieties of the Titan Arum, also emit a strong smell of decaying flesh to attract pollinators.
  - **Neelakurinji**: It is a plant species known for its rare and spectacular blooming cycle. It flowers once every 12 years, covering the hills of the Western Ghats in India.

Q 81.B

- **Recent Context:** The Indian Coast Guard (ICG) launched **two Fast Patrol Vessels (FPVs) 'Adamya' and 'Akshar',** marking a milestone in its commitment to enhanced maritime security and Indigenous manufacturing. **Hence option (b) is the correct answer.**
  - These vessels, built by Goa Shipyard Ltd. (GSL) with over 60% indigenous content, are part of an eight-vessel contract valued at Rs. 473 crores.
  - **About Fast Patrol Vessels (FPVs):**
    - **FPVs are high-speed, agile vessels primarily used for coastal patrolling, surveillance, search and rescue, anti-smuggling, and anti-piracy operations.**
    - **Dimensions:** 52 meters in length and 8 meters in breadth; displacement of 320 tons.
    - **Performance:** Equipped with a Controllable Pitch Propeller-based propulsion system, with a top speed of 27 knots.
    - **Indigenous manufacturing:** Over 60% of components are domestically sourced, supporting India's self-reliance in defense.

Q 82.B

- **Recent Context:** The recent 2024 U.S. presidential election, placed a critical emphasis on a handful of states known as "swing states" or "battleground states."
- **About Swing States:**
  - Swing states are those where neither Democratic nor Republican candidates have a consistent dominance, leading them to "swing" between parties in different elections. **Hence statement 1 is not correct.**
  - **Examples in 2024:** The primary swing states this election include Pennsylvania, Michigan, Wisconsin, Georgia, Nevada, Arizona, and North Carolina.
- **Significance of swing states:**
  - **Electoral College impact:** Swing states are crucial as they can allocate their entire electoral votes to the winner within that state, regardless of the margin. This can be decisive in a closely contested election. **Hence statement 2 is correct.**
  - **Close poll margins:** In the 2024 race, polls in these states show tight competition, with leads often within a 3.4% margin, the typical polling error.
  - **Demographic influence:** Each swing state has unique demographic groups—like Latinos in Arizona and Black voters in Georgia—that candidates aim to influence through tailored campaigns.

Q 83.D

- **Recent Context:** Saudi Arabia launched a new digital platform called Musaned Platform to ensure wage protection. It ensures a more secure working condition for foreign workers, including those from India. **Hence option (d) is the correct answer.**
  - **Coverage**: Benefits workers from 10 African countries (e.g., Sudan, Ethiopia, Kenya) and 9 Asian countries (e.g., India, Bangladesh, Pakistan).
  - **Features:**
    - Enables workers to check employment contracts.
    - Tracks financial transactions between employers and workers.
    - Links to contract insurance and health benefits.
- **Hence option (d) is the correct answer.**

Q 84.B

- **Recent Context:** SpaceX has achieved a significant milestone in space exploration by landing its Starship rocket using an innovative structure called "Mechazilla."
  - It is the nickname for the large 400-ft rocket-catching structure at SpaceX's Starbase.
- It features two enormous mechanical arms, often referred to as "chopsticks." These arms are designed to catch the Super Heavy booster in mid-air as it returns to Earth.
- **Working of Mechazilla**
  - **Launch and Ascent:** The SpaceX Starship rocket, along with its Super Heavy booster, launches from the ground.
  - **Booster Separation:** After reaching a certain altitude, the booster separates from the upper stage of the rocket.
  - **Controlled Descent:** The booster begins descending back to Earth, using precision thrusters to control its path.
  - **Catching the Booster:** As the booster nears the landing site, Mechazilla's giant arms move into position. The booster hovers briefly before the arms catch it, ensuring a safe and controlled landing.
- **Hence option (b) is the correct answer.**

Q 85.C

- **Recent Context:** The Mumbai police conducted ossification test to determine the age of one of the accused in the murder case of NCP leader and former Maharashtra Minister Baba Siddique.
- **About Ossification test:**
  - **The ossification test is a medical examination used to estimate an individual's age by assessing the development, growth, and fusion of bones, particularly the epiphyses and diaphyses in long bones.**
  - **Bones used:** Radius, ulna, humerus, tibia, fibula, femur.
  - **Accuracy:** Provides an estimate within a margin of two years (e.g., 16-18 years), allowing for a 6-month error on either side.
  - **Limitations:** Factors such as climate, diet, and heredity can affect ossification rates.
- **Hence option (c) is the correct answer.**

Q 86.A

- **Recent Context:** In a groundbreaking step for India's biotechnology sector, Union Minister Dr. Jitendra Singh formally launched the first indigenous antibiotic "Nafithromycin" for resistant infections.
- **About Nafithromycin:**
  - **Purpose: Target community-acquired** Bacterial Pneumonia (CABP) caused by drug-resistant bacteria, addressing Antimicrobial Resistance (AMR). **Hence statement 1 is correct.**
  - **Developed By:** Wockhardt with support from the Biotechnology Industry Research Assistance Council (BIRAC) under the Department of Biotechnology. **Hence statement 2 is not correct.**

- **Efficacy:**
  - 10x more effective than azithromycin.
  - Requires only a 3-day regimen.
  - Effective against both typical and atypical pathogens.
- **Features:**
  - Minimal gastrointestinal side effects.
  - No significant drug interactions.
  - Unaffected by food intake.
  - First new antibiotic in its class globally in over 30 years.

- **About AMR (Antimicrobial Resistance):** It is the ability of microorganisms such as bacteria, viruses, fungi, and parasites to resist the effects of medications designed to kill them or inhibit their growth, rendering treatments ineffective and leading to persistent infections.
  - AMR is a global health concern as it leads to prolonged hospital stays, increased medical costs, and higher mortality rates.

Q 87.D

- **Recent Context:** Following repeated directives from the Supreme Court to address stubble burning more effectively, the Commission for Air Quality Management (CAQM), has doubled fines for farmers engaging in this practice.
- **About Commission for Air Quality Management:**
  - **Origin:** The Commission for Air Quality Management (CAQM) was established in 2020 by the "Commission for Air Quality Management in National Capital Region and Adjoining Areas Ordinance, 2020", promulgated by the President of India. The ordinance was later converted into an Act of Parliament in August 2021, giving the commission a statutory status succeeding the Environment Pollution (Prevention and Control) Authority (EPCA).
  - **Aim:** To coordinate and oversee efforts for improving air quality and preventing and controlling air pollution in Delhi-NCR and neighboring states, including Punjab, Haryana, Rajasthan, and Uttar Pradesh.
  - **Jurisdiction:** Covers Delhi-NCR and the states of Punjab, Haryana, Rajasthan, and Uttar Pradesh.
  - **Powers:**
    - Restrict activities detrimental to air quality.
    - Conduct pollution-related research.
    - Issue binding directives to authorities and individuals.
    - Enforce compliance and implement preventive measures.
  - **Composition:**
    - **Chairperson:** A high-ranking official (Secretary/Chief Secretary level). **Hence option (d) is the correct answer.**
    - **Ex Officio Members:** Representatives from Delhi, Punjab, Haryana, Rajasthan, and Uttar Pradesh.
    - **Full-Time Technical Members:** Three experts in the field.
    - **NGOs and Technical Bodies:** Members from organizations like CPCB, ISRO, and NITI Aayog.

Q 88.B

- **Recent Context:** The European Central Bank (ECB) has introduced the digital euro as a central bank digital currency (CBDC) aimed at revolutionizing payment systems.
- **Digital Currency**: Digital currency refers to money in an electronic format, which can be issued by a central authority like a government or a central bank or operate in a decentralized manner (e.g., cryptocurrencies).
  - In India's context, the Reserve Bank of India (RBI) has taken a significant step by introducing the Central Bank Digital Currency (CBDC), known as the Digital Rupee (e₹), to complement traditional fiat currency and accelerate digital financial inclusion.

- **About Digital Euro:** It is a CBDC, issued directly by the ECB, enabling digital transactions without intermediaries like banks or payment gateways. **Hence option (b) is the correct answer.**
  - The preparation phase began in November 2023, with a focus on replacing cashless payment systems and reducing dependency on non-EU financial service providers.
- **Features:**
  - It facilitates direct payments via digital wallets.
  - It allows both online and offline transactions, ensuring anonymity for offline payments.
  - It offers cost-effective micropayments by bypassing conventional service providers.
  - It emphasizes european sovereignty in digital payments by reducing reliance on foreign financial entities.

Q 89.A

- **The Convention on the Conservation of Migratory Species of Wild Animals (CMS) has launched the first-ever comprehensive assessment of the state of the world's migratory species**. The report warns that almost half of the world's migratory species are in decline and more than a fifth are threatened with extinction, including nearly all of CMS-listed fish. **Hence statement 1 is correct.**
- Conservation on migratory species covers within its ambit all forms of migratory species including avian, terrestrial and aquatic species. The recently concluded CoP14 of CMS held in Samarkand (Uzbekistan) led to the introduction of three new Action Plans for aquatic species namely **The Atlantic Humpback Dolphin, The Hawksbill Turtle, The Angel Shark**. **Hence statement 2 is not correct.**
- **Half (51 per cent) of Key Biodiversity Areas identified as important for CMS-listed migratory animals do not have protected status, and 58 per cent of the monitored sites recognized as being important for CMS-listed species are experiencing unsustainable levels of human-caused pressure**. **Hence statement 3 is not correct.**

Q 90.B

- **Recent Context:** The **weather pattern known as DANA, or "gota fría" (cold drop)**, recently triggered devastating flash floods across southern and eastern Spain, causing widespread damage and fatalities.
- **Definition:** DANA, known as "depresión aislada en niveles altos" (isolated depression at high altitudes), is also referred to as "gota fría" or cold drop in Spain.
- **Formation and Mechanism:** It forms when a cold air pocket descends over the warm Mediterranean Sea, creating rapid atmospheric instability. The cold air mixes with warm, moist air, causing the warm air to rise swiftly and form cumulonimbus clouds, which result in intense rainfall. **Hence option (b) is the correct answer.**
- **Polar Jet Stream Influence:** The polar jet stream, which acts as a boundary between polar and tropical air, can sometimes detach a cold air pocket that moves over the Mediterranean, triggering DANA.
- **Seasonal Occurrence:** This weather pattern commonly occurs in the autumn and spring in the western Mediterranean region.
- **Increasing Intensity:** Due to rising sea temperatures, DANA events have become more severe and widespread. Warmer air holds more moisture, leading to heavier rainfall and more significant weather impacts.
- **Note:** DANA should not be confused with Cyclone DANA, a tropical cyclone that impacted West Bengal and Odisha in India.

Q 91.C

- **Mayong village often referred to as the "Land of Black Magic," is located in the Morigaon district of Assam.** It lies on the **banks of the river Brahmaputra**, approximately 40 km from the city of Guwahati. **Hence option (c) is the correct answer.**
- **Mayong village initiative** aims to develop the village as a cultural and eco-tourism destination while preserving its unique heritage of traditional magic and folklore.

- Efforts include showcasing the region's biodiversity, local crafts, and mysticism to attract tourists and boost the local economy.
- **Community conservation:** Villagers collectively support the nesting and **breeding of oriental pied hornbills**, ensuring their safety and well-being.
- **Plantation drive:** Fruit-bearing trees like bananas and papaya have been planted extensively to provide natural food sources for the hornbills.
- **Sacred connection:** Hornbills are revered as harbingers of peace and prosperity, fostering a harmonious relationship with the community.

- **About Oriental Pied Hornbill:**
  - **Scientific name:** Anthracoceros albirostris
  - Two other common names for this species are Sunda pied hornbill(convexus) and Malaysian pied hornbill.
  - **IUCN Status:** Least concern
  - **Habitat:** Found in subtropical or tropical moist lowland forests across the Himalayan foothills, northeast India, and Southeast Asia.
  - **Role in Ecosystem:** Known as 'forest engineers' for dispersing seeds of tropical trees, contributing to forest health.
  - **Diet:** Omnivorous, feeding on fruits, insects, shellfish, small reptiles, mammals, and bird eggs.
  - **Characteristics:** Smallest and most common of the Asian hornbills; adaptable and widespread across its range.

Q 92.A

- **Recent Context:** New studies have advanced the understanding of how birds produce their colorful displays and how these traits have evolved.
- The **term "carotenoids" refers to a class of naturally occurring pigments found in plants, algae, and photosynthetic bacteria.** These pigments are responsible for the bright yellow, orange, and red colors of many fruits and vegetables and play a crucial role in biological processes.
- **Carotenoids in Birds:**
  - Bright red, orange, and yellow feathers or bills in most birds are due to carotenoid pigments. **Hence option (a) is the correct answer.**
  - Birds acquire carotenoids through their diets, as they cannot produce them directly.
  - **Exception - Parrots:** Parrots produce unique pigments called psittacofulvins, bypassing the carotenoid dependency.
  - **Recent Findings:** Genetic sequencing advancements were used to study yellow-to-red color variations in parrots and finches.
- **Findings in Dusky Lory (Pseudeos fuscata):**
  - **Native Habitat:** New Guinea.
  - **Feather Color Variations:** Yellow, orange, or red bands.
  - **Key Discovery:**
    - > Color shifts between yellow and red feathers are linked to the enzyme ALDH3A2.
    - > High levels of ALDH3A2 in developing feathers result in yellow coloration; lower levels produce red feathers.
- **Findings in Long-tailed Finch (Poephila acuticauda):**
  - **Native Habitat:** Northern Australia.
  - **Bill Color Variations:** Two subspecies with yellow or red bills.
  - **Key Discovery:**
    - > Bill color is associated with two genes, CYP2J19 and TTC39B.
    - > These genes enable the conversion of yellow dietary carotenoids to red pigments.

Q 93.C

- **Recent Context:** The Union Minister for Road Transport and Highways recently launched the 'Humsafar Policy' to enhance the convenience of traveling on national highways and accelerate the development of wayside amenities.
- **About Humsafar policy:**
  - **Ministry:** Launched by the **Ministry of Road Transport and Highways.**
  - **Origin:** Introduced in 2024 as an initiative to improve travel experiences on national highways by developing wayside amenities and supporting environmental sustainability.
  - **Aim:** The policy aims to enhance convenience, safety, and comfort for highway travelers while promoting local economic development and ecological sustainability. **Hence option (c) is the correct answer.**
- **Key Features of Humsafar Policy:**
  - **Wayside amenities:** Establishes standardized facilities like rest areas, food courts, clean washrooms, and parking on national highways.
  - **Support for local communities:** Creates business opportunities and employment for marginalized communities.
  - **Environmental sustainability:** Promotes water and soil conservation, waste recycling, and solar energy use.
  - **Digital accessibility:** Offers travelers instant access to services via the 'Rajmarg Yatra' app.
  - **Business opportunities:** The policy aims to benefit businesses by increasing their exposure to travelers through the Rajmarg Yatra app and by providing space for signages on national highways.
  - **Road signs:** The policy aims to use road signs to tell drivers about services coming up on the highway.

Q 94.B

- **Recent Context: The Government of India has launched the National Mission on Natural Farming (NMNF) to promote natural farming in mission mode across the country** as a standalone Centrally Sponsored Scheme **under the Ministry of Agriculture & Farmers' Welfare.**
  - **In the next two years**, **NMNF will be implemented in 15,000 clusters in Gram Panchayats, which are willing, & reach 1 crore farmers and initiate Natural Farming (NF) in 7.5 lakh Ha area.** Preference will be given to areas having prevalence of practising NF farmers, FPOs, etc. Further, **need-based 10,000 Bio-input Resource Centres (BRCs) will be set-up** to provide easy availability and accessibility to ready-to-use NF inputs for farmers. **Hence, statement 1 is correct.**
  - NMNF aims at promoting Natural Farming (NF) practices for providing safe & nutritious food for all. The Mission is designed to support farmers to reduce input cost of cultivation and dependency to externally purchased inputs.
- **It envisages a single national brand for naturally grown chemical-free produce. Hence, statement 2 is correct.**
- At the national level, **National Mission on Natural Farming steered through a National Steering Committee (NSC) under the Chairmanship of Hon'ble Agriculture Minister.** NSC will be the policy making body providing overall direction and guidance to Mission, monitor and review its progress and performance. **Hence, statement 3 is not correct.**

Q 95.A

- **Recent Context: Israel and Lebanon entered into a ceasefire.** Israel and Lebanon have accepted a US-backed proposal to end the 13-month border conflict that spiraled into an all-out war.
  - **The ceasefire agreement draws on the provisions of Resolution 1701 passed by the UN Security Council (UNSC) in 2006.** UNSC Resolution 1701 aims at ending hostilities between Hezbollah and Israel, and calls for the creation of a buffer zone as well as a permanent ceasefire.
- **The resolution meant to complete the withdrawal of Israeli forces in 2000 from southern Lebanon along the 'Blue Line' and the Israel-annexed Golan Heights. The Blue Line was set by the UN in 2000 and serves as a de facto border between Israel and Lebanon.**

- **Other notable lines/boundaries in the world:**
  - **Durand Line**: Border between Afghanistan and Pakistan.
  - **38th Parallel**: Divides North Korea and South Korea.
  - **49th Parallel**: Part of the boundary between the United States and Canada.
- **Hence option (a) is the correct answer.**

Q 96.B

- **Global Alliance Against Hunger and Poverty is an initiative of the G-20 group of countries**.This initiative was championed by Brazil during its G20 presidency in 2024, to dramatically **expedite efforts to achieve the eradication of poverty and hunger by 2030 as well as to reduce inequalities**. According to a factsheet released by the Alliance, "any member country **can access proven best practices from other members and identify potential partners willing to assist in the development of its own national model**." **Hence, statements 1 and 2 are correct.**
  - The Global Alliance is set up to support national public policies such as school meals, cash transfers, maternal and early childhood nutrition, gender equality. Smallholder farmer support and water access and management schemes.
  - About **81 countries (including India)**, 26 international organisations, 9 financial institutions, and 31 philanthropic foundations and non-governmental organisations have **already joined the Alliance**.
- Unlike many initiatives, the **Alliance does not boast an exclusive fund.** Rather it envisions playing a matchmaking role, connecting countries in need with motivated donors and technical support.
  - **The $2-3 million required annually for its operations will come from member countries and institutions such as the Food and Agriculture Organization (FAO), UNICEF, and the World Bank. Hence, statement 3 is not correct.**

Q 97.A

- To achieve the objective of 'Viksit Bharat' through holistic development and empowerment of girls. **The Government of India launched the "Bal Vivah Mukt Bharat" campaign** on 27 November, 2024 **to raise awareness on the issue and eliminate child marriages across the country with a 'Whole of Government' and 'Whole of Society' approach.**
- **Prohibition of Child Marriage Act, 2006:**
  - The Government has enacted **'the Prohibition of Child Marriage Act, 2006' (PCMA)** in order to curb child marriages and to take punitive actions against those associated with child marriages. **Under this Act, child marriage is defined as the marriage of males below the age of 21 years, and females below 18 years. Hence, statement 1 is correct.**
- **Universal Declaration of Human Rights (UDHR):**
  - Article 16(1) of the UDHR stipulates that men and women of full age, without any limitation due to race, nationality, or religion, have the right to marry and to found a family.
  - **Article 16(2**) further stipulates that **marriage shall be entered into only with the free and full consent of the intending spouses**. **But it does not specify a minimum age for marriage. Hence, statement 2 is not correct.**

Q 98.A

- **Recently, the Revenue department in Kerala has initiated steps to provide land titles (patta) to the Koraga tribe (ST) group in Kasaragod** and Manjeswaram taluks under a project called Operation Smile.
  - **Koragas** are one of the Particularly Vulnerable Tribal Groups (PVTG) **found in the southern part of India particularly Kerala and Karnataka.** At present most of the Koragas are speaking Tulu languages but they have their own independent language. **Hence, pair 1 is not correctly matched.**
- **For the first time in the history of India's election process, 19 members from the Jarawa Tribe in Andaman and Nicobar Islands have been included in India's electoral roll**.

- The Jarawas are an **indigenous tribe which lives in the Andaman Islands**. They are also recognized as one of the 75 PVTG. **Hence, pair 2 is correctly matched.**

- **Recently,** the **Reang community requested the government to grant recognition to their language, Kaubru**, which is the oral language of the Bru ethnic people and also **demanded declaration of a holiday on the day of the Hojagiri festival.**
  - Reang are the **second largest tribal community of Tripura.** The Reang community in Tripura, one of the 75 Particularly Vulnerable Tribal Groups (PVTGs) in the country. **Hence, pair 3 is not correctly matched.**

Q 99.A

- **At COP29, United Nations Industrial Development Organization (UNIDO) and the Climate Club launched the Global Matchmaking Platform (GMP)**. GMP is a support mechanism of Climate Club, **with secretariat hosted by UNIDO**. It was launched in the presence of partner countries, key donor and partner organisations. **Hence, Statement-I is correct.**
  - **The Global Matchmaking Platform is designed to fast-track the decarbonisation of heavy-emitting industries in emerging and developing economies** by connecting to technical and financial solutions. **It's accessible to all emerging & developing economies**. The matchmaking process aims to address the unique needs of different countries and provide the right support. **Hence, Statement-II is the correct explanation for Statement-I.**
- **About UNIDO:** The United Nations Industrial Development Organization (UNIDO) is a **specialized agency of the United Nations** that focuses on promoting industrial development for poverty reduction, inclusive globalization, and environmental sustainability. **Established in 1966, UNIDO plays a crucial role in supporting developing countries and economies in transition to achieve sustainable industrial growth.**

Q 100.C

- The UN refugee agency, **United Nations High Commissioner for Refugees (UNHCR), has launched a $10 billion appeal for 2025 to meet critical needs and implement sustainable solutions for millions of refugees, displaced persons and stateless people worldwide.**
  - This Global Appeal highlights UNHCR's plans for 2025 and the funding it needs to protect, assist and empower a record number of forcibly displaced and stateless people, and to help them find solutions to their situations.
- **Hence, option (c) is the correct answer.**