ANSWERS & EXPLANATIONS
GENERAL STUDIES (P) TEST – 4145 (2024)

Q 1.D

- **The Madden-Julian oscillation (MJO) is an equatorial traveling pattern of anomalous rainfall that is planetary in scale. The MJO is characterized by an eastward progression of clouds, rainfall, winds, and pressure that traverses the planet in the tropics and returns to its initial starting point in 30 to 60 days, on average.**
- **It is observed mainly over the Indian Ocean and Pacific Ocean. Hence both statements 1 and 2 are not correct.**
- The anomalous rainfall is usually first evident over the western Indian Ocean and remains evident as it propagates over the very warm ocean waters of the western and central tropical Pacific.
  - This pattern of tropical rainfall then generally becomes very nondescript as it moves over the cooler ocean waters of the eastern Pacific but reappears over the tropical Atlantic and Indian Oceans.
  - The wet phase of enhanced convection and precipitation is followed by a dry phase where thunderstorm activity is suppressed. Each cycle lasts approximately 30-60 days.
  - Because of this pattern, The MJO is also known as the 30-60 day oscillation, 30-60 day wave, or intra-seasonal oscillation.
- It propagates eastward across the equatorial Indian and western/central Pacific oceans, with a local intra-seasonal period of 30-90 days.
- This phenomenon- Madden-Julian Oscillation (MJO) was first documented by Madden and Julian, the MJO has intrigued many atmospheric scientists and oceanographers all over the world.
- There are distinct patterns of lower-level atmospheric circulation anomalies that accompany the MJO-related pattern of enhanced or decreased tropical rainfall across the tropics.
  - These circulation features extend around the globe and are not confined to only the eastern hemisphere. The Madden-Julian oscillation moves eastward at 5 meters per second (11 mph) across the tropics, crossing the Earth's tropics in 30 to 60 days.

Q 2.A

- **Vernalization**
  - **Vernalization is a process in ecology that involves the exposure of a plant to cold temperatures,** typically during the winter season.
  - This exposure to prolonged cold is essential for inducing or promoting the process of flowering in certain plant species. It is particularly crucial for plants that are adapted to temperate climates.
  - The mechanism behind vernalization lies in the response of the plant to the chilling requirement, which is the exposure to a specific duration of cold temperatures.
  - **This process helps the plant transition from the vegetative phase to the reproductive phase,** ultimately leading to the initiation of flower buds. **Hence option (a) is the correct answer.**
- **Ecological Significance of Vernalization**
  - **Vernalization is an adaptive trait** that is particularly important for plants that grow in temperate and Arctic regions.
  - By requiring a period of cold exposure before flowering, vernalization ensures that plants do not flower prematurely during the winter when conditions are unfavorable for seed development and survival.
  - Instead, flowering is delayed until the spring, when temperatures are warmer, rainfall is more reliable, and there is sufficient light for photosynthesis.
  - Numerous plant species exhibit vernalization requirements, including **Winter wheat, Apples, Arabidopsis thaliana e.t.c**

Q 3.A

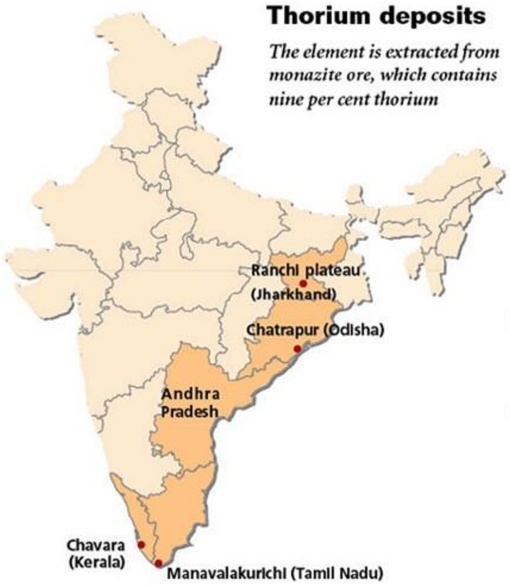
- **Recent Context: In elections held at its assembly on Friday for the 2024–25 biennium, India was re-elected to the International Maritime Organisation (IMO) Council with the highest tally.**
- **IMO – the International Maritime Organization – is the United Nations specialized agency with responsibility for the safety and security of shipping and the prevention of marine and atmospheric pollution by ships. IMO's work supports the UN sustainable development goals. Hence, statement 1 is correct.**
- IMO's organizational structure consists of the IMO assembly, IMO council and five main committees. The IMO Assembly consists of all Member States and is the highest governing body of the Organization. It is responsible for approving the work programme, voting on the budget and determining the IMO's financial arrangements.
- The IMO Council is elected by the Assembly for terms of two years. It acts as the Executive Organ of IMO and is responsible, under the Assembly, for supervising the work of the Organization.
- **Council members are categorized as:**
  - Category (a): 10 States with the largest interest in providing international shipping services
  - **Category (b): 10 States with the largest interest in international seaborne trade (of which India is a member).**
  - Category (c): 20 States not elected under (a) or (b) above, which have special interests in maritime transport or navigation and whose election to the Council will ensure the representation of all major geographic areas of the world
- India's re-election falls under the Category of 10 states with "the largest interest in international seaborne trade", alongside Australia, Brazil, Canada, France, Germany, the Netherlands, Spain, Sweden, and the United Arab Emirates (UAE). **Hence, statement 2 is not correct.**
- **India has been one of the earliest members of the IMO, having ratified its Convention and joined it as a member-state in the year 1959. India has had the privilege of being elected to and serving the Council of the IMO, ever since it started functioning, and till date, except for two years for the period 1983-1984. Hence, statement 3 is not correct.**

Q 4.B

- **Primary Productivity:**
  - Primary production is defined as the amount of biomass or organic matter produced per unit area over a time period by plants during photosynthesis. It is expressed in terms of weight (g m–2) or energy (kcal m–2).
  - It can be divided into **gross primary productivity (GPP)** and **net primary productivity** (NPP).
  - The gross primary productivity of an ecosystem is the rate of production of organic matter during photosynthesis. A considerable amount of GPP is utilized by plants in respiration. **Gross primary productivity minus respiration losses (R), is the net primary productivity (NPP).**
- **Primary Productivity of Oceans:**
  - The annual net primary productivity of the whole biosphere is approximately 170 billion tons (dry weight) of organic matter. Of this, despite occupying about 70 percent of the surface, the productivity of the oceans is only 55 billion tons. The rest, of course, is on land. **Hence, statement 1 is not correct.**
  - **The main reason for the low productivity in Oceans is Sunlight**. The aquatic ecosystems are limited by light which decreases with increasing water depth. As the depth of the ocean increases, the intensity of light decreases, thus decreasing the photosynthetic rate. This decrease in the rate of photosynthesis will eventually decline the development of plants and animals thriving in the aquatic environment**.**
- **Secondary productivity:**
  - **Secondary productivity measures the rate at which consumers (herbivores, carnivores, and omnivores) convert the organic matter they consume into new biomass. Hence statement 2 is correct.**
  - It essentially quantifies how efficiently consumers utilize the primary production (NPP) in an ecosystem to produce their own biomass.
  - Secondary productivity is a critical metric in understanding energy flow through food chains and the transfer of energy from lower trophic levels to higher trophic levels. It reflects the capacity of consumers to convert plant and algal material into animal biomass, which can then be consumed by higher-level predators.

Q 5.C

- **Statement 1 is correct:** Thorium is mainly obtained from monazite and ilmenite in the beach sands along the coast of Kerala and Tamil Nadu. World's richest monazite deposits occur in Palakkad and Kollam districts of Kerala, near Visakhapatnam in Andhra Pradesh and Mahanadi river delta in Odisha.
- **Statement 2 is not correct:** Thorium is not present in Narmada-Tapti basin.
- **Statement 3 is correct:** Chevara in Kerala, Chatrapur in Odisha and Ranchi Plateau in Jharkhand are famous or Thorium extraction.



Q 6.B

- **Recent Context: India, as the Incoming Support Chair of the Global Partnership on Artificial Intelligence (GPAI), stands at the forefront, proudly hosting the annual GPAI Summit from December 12-14, 2023, at the Bharat Mandapam in New Delhi.**
- **The Global Partnership on Artificial Intelligence or GPAI is an international and multistakeholder initiative to guide the responsible development and use of artificial intelligence consistent with human rights, fundamental freedoms, and shared democratic values, as reflected in the OECD Recommendation on AI. Hence, statement 1 is correct.**
- GPAI's founding members include Australia, Canada, France, Germany, India, Italy, Japan, Mexico, New Zealand, the Republic of Korea, Singapore, Slovenia, the United Kingdom, the United States of America, and the European Union. Currently, It has 29 member countries.
- GPAI brings together leading experts from industry, civil society, governments, and academia to bridge the gap between theory and practice on AI by supporting cutting-edge research and applied activities on AI-related priorities with the goal of fostering international cooperation.
- **GPAI secretariat is hosted by the Organisation for Economic Co-operation and Development. The OECD is also a Permanent Observer to GPAI's governing bodies and contributes experts to participate in GPAI's Working Groups and the annual Multistakeholder Experts Group Plenary. Hence, statement 2 is correct.**
- **The first three GPAI summits were held in Montreal, Paris and Tokyo respectively. India, which took over the presidency of the GPAI in November last year, will host the three-day summit in December 2023. Hence, statement 3 is not correct.**
- At this year's summit, India will also work with other members of the GPAI to look at ways in which AI can be used for the betterment of sustainable agriculture and collaboration, especially in the areas of digital public infrastructure.

Q 7.B

- **The biogeochemical cycle that does not have an atmospheric component is the Phosphorus Cycle.** Unlike other cycles such as the Carbon or Nitrogen cycles, phosphorus primarily cycles through terrestrial and aquatic ecosystems without a significant atmospheric phase.
  - Phosphorus is released from rocks and minerals, then it enters water bodies through weathering and runoff, where it is cycled within aquatic ecosystems and eventually incorporated into sediments. This lack of a gaseous phase in the atmosphere is a distinctive feature of the phosphorus cycle among Biogeochemical cycles. **Hence option (b) is the correct answer.**

- **Phosphorous Cycle:**
  - **Weathering:** The cycle begins with the weathering of rocks that contain phosphorus minerals. Over time, these minerals break down, releasing phosphates into the soil.
  - **Plant Uptake:** Phosphorus in the form of phosphate ions is taken up by plants through their roots. It is an essential nutrient for plant growth and development.
  - **Consumers:** Herbivores and other animals obtain phosphorus by consuming plants. Phosphorus is transferred through the food chain as animals eat other animals.
  - **Decomposition:** When organisms die or produce waste, phosphorus is returned to the soil in the form of organic matter.
  - **Phosphate-Solubilizing Bacteria:** Specialized bacteria help release phosphorus from organic matter in the soil, converting it into a form that plants can take up again.
  - **Runoff:** Some phosphorus may also enter water bodies through runoff from the land. This can contribute to aquatic ecosystems.
  - **Sedimentation:** In aquatic ecosystems, phosphorus can settle and become part of the sediment. Over time, this can lead to the formation of new rock with phosphorus deposits.

Q 8.D

- **Recent Context: Recently, a Lok Sabha MP was accused of cash for query scam and the Lok Sabha Ethics Committee took up the investigation against the MP.**
- **A Presiding Officers' Conference held in Delhi in 1996 first mooted the idea of ethics panels for the two Houses.** Then Vice President (and Rajya Sabha Chairman) K R Narayanan constituted the Ethics Committee of the Upper House on March 4, 1997, and it was inaugurated that May to oversee the moral and ethical conduct of members and examine cases of misconduct referred to it. The Rules applicable to the Committee of Privileges also apply to the ethics panel. **Hence, statement 1 is not correct.**
- In the case of Lok Sabha, a study group of the House Committee of Privileges, after visiting Australia, the UK, and the US in 1997 to look into practices pertaining to the conduct and ethics of legislators, recommended the constitution of an Ethics Committee, but it could not be taken up by Lok Sabha.
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- **Any person can complain against a Member through another Lok Sabha MP, along with evidence of the alleged misconduct, and an affidavit stating that the complaint is not "false, frivolous, or vexatious". If the Member himself complains, the affidavit is not needed.** The Committee does not entertain complaints based only on media reports or on matters that are sub judice. The Committee makes a prima facie inquiry before deciding to examine a complaint. It makes its recommendations after evaluating the complaint. The Committee presents its report to the Speaker, who asks the House if the report should be taken up for consideration. There is also a provision for a half-hour discussion on the report. **Hence, statement 2 is not correct.**
- **The work of the Ethics Committee and the Privileges Committee often overlap. An allegation of corruption against an MP can be sent to either body, but usually, more serious accusations go to the Privileges Committee. The Ethics Committee can take up only cases of misconduct that involve MPs.**

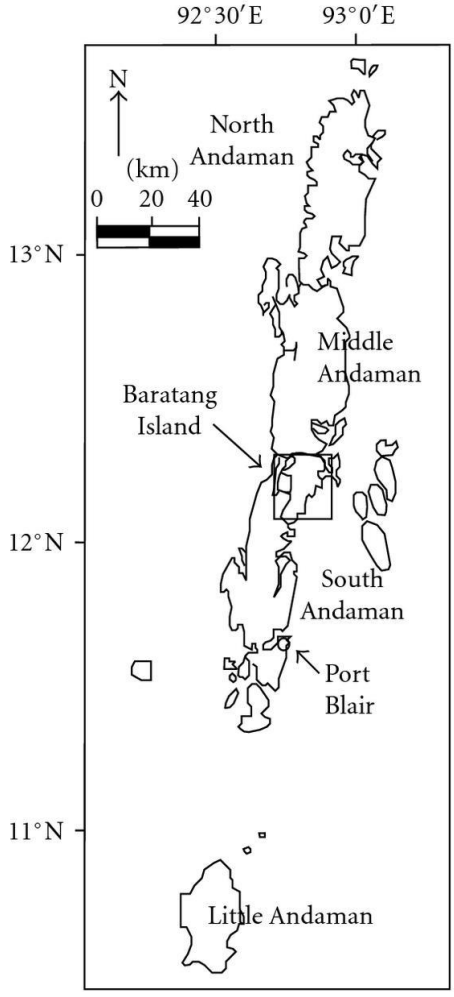
Q 9.B

- **Recent Context:** Five countries in East and Southern Africa are in the middle of outbreaks of the anthrax disease, with more than 1,100 suspected cases and 20 deaths this year, the World Health Organization said on December 11.
- **Anthrax is a disease caused by the gram-positive, rod-shaped bacteria known as Bacillus anthracis. Hence, statement 1 is correct.**
- **Anthrax usually affects livestock like cattle, sheep and goats, as well as wild herbivores. Humans can be infected if they are exposed to animals or contaminated animal products. Anthrax isn't generally considered to be contagious between humans, although there have been rare cases of person-to-person transmission, WHO says. Hence, statement 2 is correct.**

- **Anthrax is sometimes associated with the weaponized version used in the 2001 attacks in the United States** when five people died and 17 others fell sick after being exposed to anthrax spores in letters sent through the mail. **Anthrax bacteria also occur naturally in soil.**
- The disease manifests in three forms depending on the route of infection: cutaneous, gastrointestinal, and inhalational. Cutaneous anthrax, the most common form, presents with itchy bumps that develop into black sores, often accompanied by fever and muscle aches.
- **Anthrax can be diagnosed by identifying Bacillus anthracis in blood, skin lesions, or respiratory secretions through laboratory culture, or ELISA tests. Treatment for anthrax is available and includes antibiotics such as ciprofloxacin, doxycycline, or levofloxacin. Hence, statement 3 is not correct.**

Q 10.B

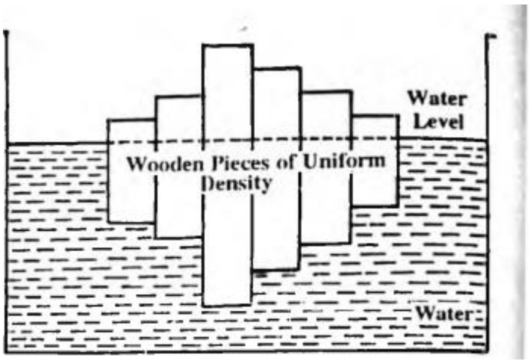
- Baratang Island is an island of the Andaman Islands. It belongs to the North and Middle Andaman administrative district. The island belongs to the Great Andaman Chain.
- Beaches, mangrove creeks, and **limestone caves** are some of the physical features.
- **Baratang contains the only known examples of mud volcanoes in India. These mud volcanoes have erupted sporadically.**
- Baratang Island is also home to the Jarawa tribe.



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

Q 11.B

- **Isostasy is a geological concept** that pertains to the **equilibrium or balance of the Earth's lithosphere (the rigid outer layer of the Earth) on the more fluid asthenosphere beneath it.** The key idea is that the **Earth's lithosphere "floats" on the semi-fluid asthenosphere** in such a way that the mass of the lithosphere is **compensated by its buoyancy** in the underlying mantle.
- The term isostasy comes from the Greek words **"isos," meaning equal,** and "**stasis," meaning standing still or balance.** The concept is based on Archimedes' principle, which states that a **floating object displaces its own weight of fluid.**



- isostasy works on the principle of:
  - **Floating Blocks:** The Earth's **lithosphere is not a continuous, unbroken shell**; rather, it is divided into large, rigid blocks called tectonic plates. These plates "float" on the more ductile asthenosphere beneath them.
  - **Compensation**: **Isostatic equilibrium is maintained** when the mass of the lithospheric plate is balanced by the buoyancy it experiences due to its displacement of the denser material below.
  - **Vertical Adjustments**: Changes in the thickness or density of the lithosphere can lead to vertical adjustments.
- **Isostasy plays a crucial role in understanding processes** such as **mountain building, subsidence, and the formation of Earth's topography**. It helps explain why high mountain ranges have deep roots extending into the mantle and why continental crust, which is less dense than oceanic crust, stands higher above sea level.
- **Hence, option (b) is the correct answer.**

Q 12.B

- Kaveri (Cauvery) is the most revered and sacred river of south India and is designated as the "Dakshina Ganga' or 'the Ganga of the South'.
- The Source of this river lies at Taal Cauvery on the Brahmagiri range of hills in the Western Ghats at 1,341 m elevation situated in the Coorg Plateau (Coorg district of Karnataka).
- It flows eastwards for a distance of about 800 km before it empties in the Bay of Bengal. This river is unique in the sense that its upper catchment area receives rainfall during summer by the south-west monsoon and the lower catchment area during winter season by the retreating north-east monsoon.
- It is, therefore, almost a perennial river with comparatively less fluctuations in flow and is very useful for irrigation and hydroelectric power generation.
- The river descends from the South Karnataka Plateau to the Tamil Nadu Plains through the Sivasamudram waterfalls (101 m high).
- The river divides itself into two distinct channels at Srirangam. The northern channel is called Kollidam (Coleroon) while the southern one retains the name Cauvery.
- The water flowing in the Cauvery is supplemented by a large number of tributaries which join the master river at different places. **The main tributaries** are the Herangi, the **Hemavati**, the Lokpavani, the Srimsha and the Arkavati from the north and the Laksmontirthe, the **Kabani**, the Suvarnavati, the Bhavani and the Amravati from the south.
- **Indravati is a tributary of godavari river.**
- **Hence option (b) is the correct answer.**

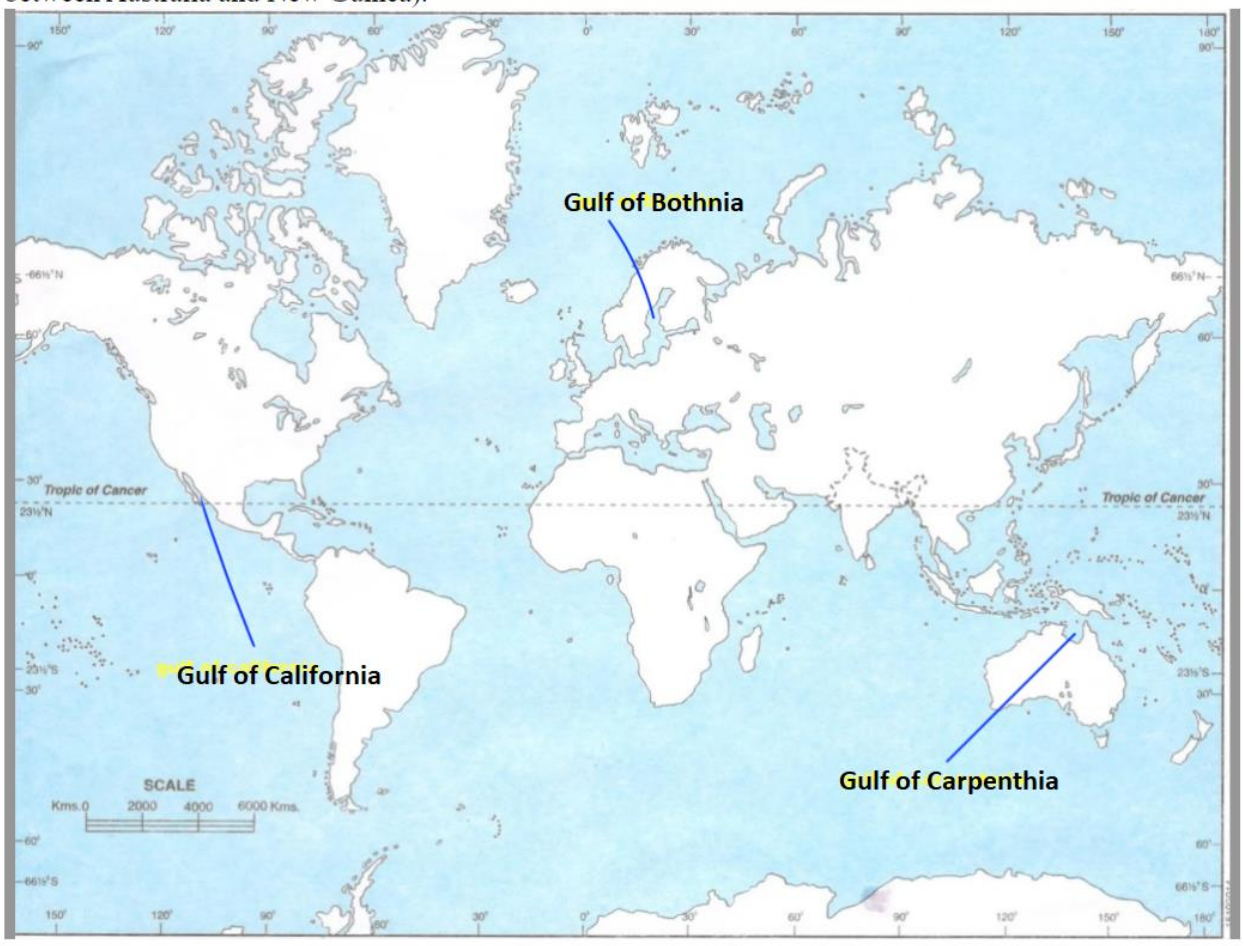
Q 13.C

- In the context of climate change, radiative forcing is a measure of the influence a factor has in altering the balance of incoming and outgoing energy in the Earth's atmosphere. Positive radiative forcing tends to warm the planet, while negative radiative forcing tends to cool it. Let's examine each of the components you listed:
- **Carbon Dioxide (CO2): Positive Radiative Forcing**
  - CO2 is a major greenhouse gas that contributes to the trapping of heat in the Earth's atmosphere. Human activities, such as burning fossil fuels and deforestation, have significantly increased CO2 concentrations, leading to positive radiative forcing and contributing to global warming.
- **Methane (CH4): Positive Radiative Forcing**
  - Methane is another potent greenhouse gas. While it doesn't persist as long as CO2 in the atmosphere, it is more effective at trapping heat. Anthropogenic sources, including livestock and fossil fuel production, contribute to increased methane levels, resulting in positive radiative forcing.

- **Tropospheric Ozone: Positive Radiative Forcing**
  - Ozone in the troposphere, the lower part of the Earth's atmosphere, acts as a greenhouse gas. While natural processes and human activities contribute to tropospheric ozone, emissions of ozone precursors (nitrogen oxides and volatile organic compounds) from human activities enhance its levels, leading to positive radiative forcing.
- **Stratospheric Ozone: Negative Radiative Forcing**
  - Ozone in the stratosphere plays a crucial role in blocking harmful ultraviolet (UV) radiation from the sun. However, due to human-made substances like chlorofluorocarbons (CFCs), stratospheric ozone has been depleted, resulting in negative radiative forcing. This depletion allows more UV radiation to reach the Earth's surface.
- **Aerosols: Both Positive and Negative Radiative Forcing**
  - Aerosols, tiny particles or droplets in the atmosphere, can have both positive and negative radiative forcing effects. Some aerosols, like **sulfate aerosols, reflect sunlight back into space, leading to a cooling effect (negative radiative forcing)**.
  - However, certain aerosols, such as **black carbon**, can absorb sunlight, causing warming (positive radiative forcing). The overall impact depends on the type and distribution of aerosols.
- **Hence option (c) is the correct answer.**

Q 14.A

- Gulf is a large body of sea or ocean water, typically larger than a bay, that is partially enclosed by land.
- **The Gulf of Bothnia** is part of the Baltic Sea and has a surface area of around 116,300 km2. It is sandwiched between Sweden and Finland. The southern border of the sea is marked off by the Åland Islands.
- **Gulf of California** is a long and narrow extension of the Eastern Pacific Ocean and is geographically positioned along the northwestern coast of Mexico. The Gulf of California separates the mountainous Lower California Peninsula/Baja California Peninsula in the west from the states of Sonora and Sinaloa on the mainland of Mexico in the east.
- **The Gulf of Carpentaria** is a large, shallow sea enclosed on three sides by northern Australia and bounded on the north by the eastern Arafura Sea (the body of water that lies between Australia and New Guinea).



Q 15.C

- **Zuari River** is the largest river in the state of Goa, India. It is a tidal river.
  - The river originates at Hemad-Barshem in the Western Ghats. The Zuari River is also referred to as the "Aghanashani" in the interior regions of Goa. Zuari is 92 km long but is connected to other rivers and canals such as the Mandovi River and Cumbarjuem Canal.
  - **The waters of the Mandovi and Zuari both flush out into the Arabian Sea at Cabo Aguada**, a common point forming the Mormugao Harbour.
- **Sharavati River is** in western Karnataka state, southern India. Rising in the Western Ghats, it flows for 60 miles (100 km) **in a northwesterly direction to the Arabian Sea at Honavar.**
  - On its way, the Sharavati forms the Jog Falls where the river falls from a height of 253 m. The river is dammed at Linganamakki.
- **The Bharathapuzha River is the second longest-flowing river that drains into the Arabian Sea in Kerala State.**
  - The Gayathripuzha, the Kalpathipuzha, and the Pulanthode, are the three important tributaries. All three tributaries rise in the Western slopes of the different ranges of the Western Ghats and drain a major part of the Palghat, Trichur and Malappuram districts.
  - At present, there are 13 completed structures either reservoirs or weirs in the Bharathapuzha catchment out of which there are three important structures namely the Aliyar Reservoir, Tirumurthi Reservoir, and Malampuzha Reservoir.
- **The Vaigai river** rises on the Eastern slopes of the Varushanadu hills at an elevation of 1,200 m above near Kottaimalai in the Madurai district and flows in the Northerly and North-Easterly directions up to its confluence with the Varahanadhi and then takes a turn towards the East and South-East to flow through Madurai, Sivagangai and Ramanathapuram districts.
  - **After traversing for about 258 Km, the river Vaigai discharges into Ramnad big tank and some other tanks. The surplus water from the tanks finally discharges into the Palk Bay, Bay of Bengal.**
  - On its way, the Vaigai receives two important tributaries namely, the Suruliyar and the Manjalar on its left bank, besides a large number of small streams and rivulets.
- **Hence option (c) is the correct answer.**

Q 16.C

- The **blend between diesel and ethanol (**also called “diesohol”) has been considered as one of the candidate alternative fuels for diesel substitution. The use of ethanol blended with diesel fuel in a compression ignition engine has some potential for exhaust black smoke reduction. **Hence, statement 1 is correct.**
- **Doping of ethanol with petrol supplies extra oxygen for complete combustion, which reduces carbon monoxide levels in auto emissions and therefore, it is considered more environment friendly as it lessens air pollution.**
- **Hindustan Petroleum Corporation Limited (HPCL) has successfully launched a groundbreaking pilot study on vehicles using E27 fuel and Ethanol Blended Diesel Fuel. Under the aegis of MoP&NG, HPCL has become the first Oil Marketing Company in India to initiate such a comprehensive research program, in line with the "Roadmap for Ethanol Blending in India by 2025," which aims to promote the adoption of Ethanol Blending in gasoline. Hence, statement 2 is correct.**
- The roadmap, designed to usher in a greener and more sustainable future, outlines a phased rollout plan for achieving 20% Ethanol Blended Gasoline (E20) by April 2023 and ensuring its widespread availability by April 2025. It further emphasizes the introduction of E20 material-compliant and E10 engine-tuned vehicles starting from April 2023, followed by the production of E20-tuned engine vehicles from April 2025.
- The pilot study of E27 fuel will focus on assessing its performance and emissions in engines and vehicles through extended mileage accumulation. Mileage accumulation of up to 10,000 km for two-wheelers and 20,000 km for passenger cars using E27 fuel is planned for this phase. Ethanol trials, in accordance with IS 1460:2017 fuel specifications, will also be conducted in conjunction with biodiesel-diesel.
- Looking ahead, India's next milestone in the Ethanol blending program is achieving 27% Ethanol blending beyond E20 fuel. With the success of the ongoing trials and the achievement of E27 fuel, India will proudly stand side by side with Brazil on the global platform in the Ethanol blending program.

Q 17.C

- **The per-and polyfluoroalkyl substances (PFAS) are a group of chemicals used to make fluoropolymer coatings and products that resist heat, oil, stains, grease, and water. They do not occur naturally. Being widely used, long-lasting chemicals, components of which break down very slowly over time. Hence, statement 1 is not correct but statement 2 is correct.**
- Fluoropolymer coatings can be in a variety of products. These include clothing, furniture, adhesives, food packaging, heat-resistant non-stick cooking surfaces, and the insulation of electrical wire.
- **Because of their widespread use and their persistence in the environment, many PFAS are found in the blood of people and animals all over the world and are present at low levels in a variety of food products and in the environment. Scientific studies have shown that exposure to some PFAS in the environment may be linked to harmful health effects in humans and animals. Hence, statement 3 is correct.**
- Human health effects from exposure to low environmental levels of PFAS are uncertain. Studies of laboratory animals given large amounts of PFAS indicate that some PFAS may affect growth and development. In addition, these animal studies indicate PFAS may affect reproduction, thyroid function, the immune system, and injure the liver. Epidemiologic studies on PFAS exposure evaluated several health effects.

Q 18.B

- **Recent Context: The Coalition for Disaster Resilient Infrastructure released the first-ever biennial report to lay down the political and economic ground for the need to invest in disaster-resilient infrastructure.**
- **Named 'Global Infrastructure Resilience: Capturing the Resilience Dividend', the report brings together for the first time a unique body of evidence to make a compelling economic, political, and financial case to radically upscale investment in infrastructure resilience**. The Global Infrastructure Risk Model and Resilience Index (GIRI) developed by a consortium of scientific and technical organizations, has generated, for the first time ever, a suite of publicly available financial risk metrics for each country and territory in the world, for all major infrastructure sectors and for most major hazards.
- **The Coalition for Disaster Resilient Infrastructure (CDRI) is a partnership of national governments, UN agencies and programmes, multilateral development banks and financing mechanisms, the private sector, and knowledge institutions** that aims to promote the resilience of new and existing infrastructure systems to climate and disaster risks in support of sustainable development. **Hence, statement 1 is not correct.**
- **The Prime Minister of India launched CDRI during his speech at the UN Climate Action Summit on 23 September 2019.** The Prime Minister had initially announced India's intention to work with partner countries and key stakeholders to form a coalition working towards the goal of improving the disaster resilience of infrastructure at the Asian Ministerial Conference on Disaster Risk Reduction (AMCDRR) held in November 2016 in New Delhi. **Hence, statement 2 is correct.**
- The coalition in its report highlighted the urgent need for resilient infrastructure to mitigate the impacts of climate-related disasters and ensure sustainable economic development.The report revealed an average annual loss of over $700 billion is incurred due to asset loss and service disruptions associated with disaster and climate risk across the world, with low-income countries facing the major brunt.
- The organization emphasized that 60 percent of the infrastructure required by 2050 to achieve sustainable development goals and net-zero emissions is yet to be built, raising the need for rapid investments. The report estimates that an annual investment of $9.2 trillion is needed to address infrastructure deficits. Of this, $2.76 trillion must be invested in low- and middle-income countries.

Q 19.B

- Recently, scientists at a research institute in India's Hyderabad discovered light rare earth elements (REE) in the Anantapur district of Andhra Pradesh, about 2,000 km south of the national capital New Delhi.
- The light rare earth element minerals found in Ananthapur district include allanite, ceriate, thorite, columbite, tantalite, apatite, zircon, monazite, pyrochlore euxenite and fluorite.
- The discovery of these elements has implications for the country's electronics and clean energy sectors. This will reduce India's reliance on foreign imports of these critical minerals.
- **Rare earths are 15 elements referred to in the lanthanide and Actinide series of the periodic table of elements. Hence, statement 1 is correct.**
- **The Rare Earth (RE) resources in India are reported to be the fifth largest in the world.**

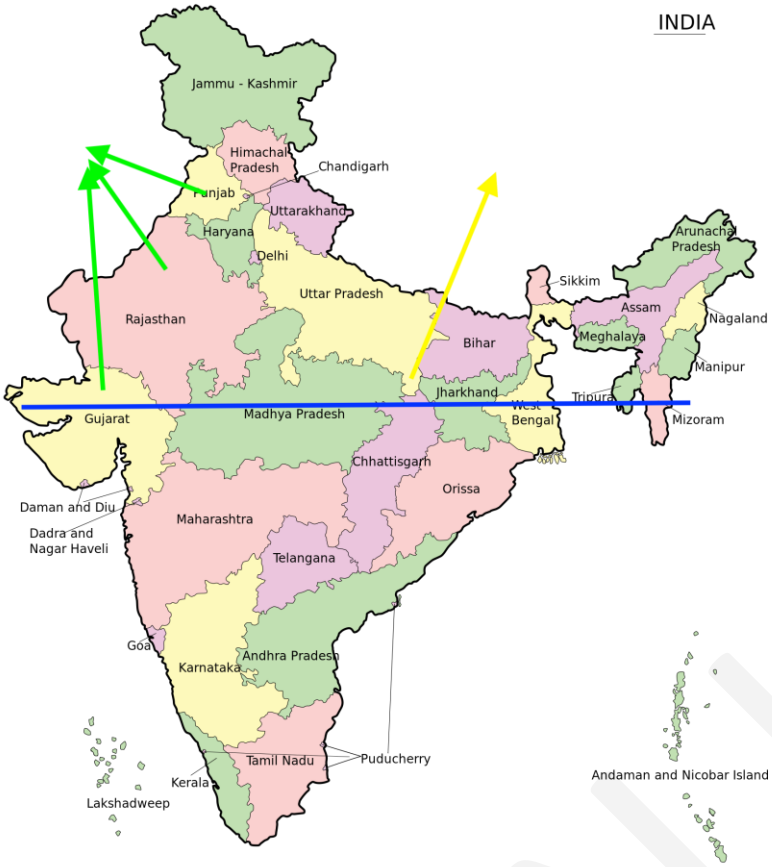
- Indian resource is significantly lean w.r.t. grade and it is tied with radioactivity making the extraction long, complex and expensive.
- **Further, Indian resources contain Light Rare Earth Elements (LREE) while Heavy Rare Earth Elements (HREE) are not available in extractable quantities. Hence, statement 3 is not correct.**
- **While India has existing facilities from mining to separation and refining in oxide form and also developed capability of metal extraction, further industrial-scale facilities (intermediate) from alloy, magnet etc. are non-existent. Hence, statement 2 is correct.**
- In these alloys, RE is a minor component and other than Rare Earth Elements (REE) many other materials are required. Though from the stages of metal extraction onwards, the sector is under the free category, the industry in the intermediate segment have not been established due to the non-availability of technology.
- More than 80 % of the usage of rare earths in value terms is in RE permanent magnets which require Magnetic REE i.e. Neodymium, Praseodymium, Dysprosium and Terbium. These are precious REEs since they find use in energy transition initiatives. High value REE are Dysprosium and Terbium which are not available in extractable quantities in Indian reserves already under exploitation. In Indian deposits, only Neodymium and Praseodymium are available and are being extracted up to 99.9 % purity level.

Q 20.A

- The **moon is the only natural satellite of the earth.** Like the origin of the earth, there have been attempts to explain how the moon was formed**. The "Big Splat" event is often associated** with a hypothesis called the **"Giant Impact Hypothesis,"** which explains the **formation of the Moon.**
- The formation of the moon, as a satellite of the earth, is an outcome of a 'giant impact' or what is described as **"the big splat"**. A body the size of **one to three times that of Mars collided with the Earth** sometime shortly after the Earth was formed.
- It blasted a large part of the earth into space. This **portion of blasted material then continued to orbit the earth and eventually formed into the present moon** about 4.44 billion years ago.
- **Hence option (a) is the correct answer.**

Q 21.B

- India is located in South Asia, bordered by Pakistan to the northwest, China and Nepal to the north, Bhutan to the northeast, and Bangladesh and Myanmar to the east. To the south, it is bounded by the Indian Ocean.
- **India is a federal union comprising 28 states and 8 union territories**. Union territories are Andaman and Nicobar Islands, Chandigarh, Dadra and Nagar Haveli and Daman and Diu, Jammu and Kashmir, Ladakh, Lakshadweep, National Capital Territory of Delhi, Puducherry.
- **Uttar Pradesh shares its border** with the states of Uttarakhand and Himachal Pradesh in the north, the states of Haryana and Rajasthan in the west, Madhya Pradesh and **Chhattisgarh in the South,** and in the east with the states of Jharkhand and Bihar and the Union territory of Delhi.
  - Uttar Pradesh touches the border of most states in India. **Hence statement 1 is not correct.**
- **Three Indian states share a border with Pakistan: Punjab, Rajasthan, and Gujarat.** Apart from this Union territories of Jammu and Kashmir and Ladakh also share a border with Pakistan. **Hence statement 2 is correct.**
- **The Tropic of Cancer passes through these 8 states in India**: Gujarat, Rajasthan, Madhya Pradesh, Chattisgarh, Jharkhand, West Bengal, Tripura, and Mizoram.
  - **The Tropic of Cancer does not pass through Manipur. Hence statement 3 is correct.**
- Rajasthan is the largest state in India in terms of area which covers 342,239 km2 of land area. Goa is India's smallest state, covering just 3,702 sq km.
- Indian states that share borders with Bangladesh are Assam, West Bengal, Mizoram, Meghalaya, and Tripura.
- India shares a border with China that runs along the states of Himachal Pradesh, Sikkim, Uttarakhand, and Arunachal Pradesh.



Q 22.B

- **Recently, the Geological Survey of India discovered lithium reserves in the Reasi district of Jammu and Kashmir. Hence, statement 2 is correct.**
- **Argentina, together with Chile and Bolivia, form the so-called "Lithium Triangle" and is currently the fourth largest producer. It has the world's third-largest lithium reserve. Hence, statement 1 is correct.**
- India imports all major components that go into lithium-ion cell manufacturing. The country's lithium-ion import bill for FY23 was ₹23,171 crore. In FY22, imports for lithium-ion were ₹13,673.15 crore.
- **KABIL is a joint venture between the National Aluminium Company (NALCO), Mineral Exploration Corporation Ltd. (MECL), and Hindustan Copper Ltd. (HCL). It was formed for the identification, acquisition, development, and processing of strategic minerals overseas for use in India. Hence, statement 3 is not correct.**
    - So far, India has always been import-dependent, not only for lithium but also for other minerals such as nickel and cobalt. Now, to reduce dependency on imports and grow further in the EV manufacturing space, experts reckon the government has lifted the ban on lithium mining.
- **Hence option (b) is the correct answer.**

Q 23.D

- **Since 2000, the International Organization for Migration (IOM) has been producing its flagship world migration reports every two years. Hence, statement 1 is not correct.**
- The World Migration Report 2022, the eleventh in the World Migration Report series, has been produced to contribute to an increased understanding of migration and mobility throughout the world.
- This new edition presents key data and information on migration as well as thematic chapters on highly topical migration issues, and is structured to focus on two key contributions for readers:
    - Part I: key information on migration and migrants (including migration-related statistics); and
    - Part II: balanced, evidence-based analysis of complex and emerging migration issues.
- **This flagship World Migration Report has been produced in line with IOM's Environment Policy and is available online only. Hence, statement 2 is not correct.**
- Printed hard copies have not been made in order to reduce paper, printing and transportation impacts.
- **Hence, option (d) is the correct answer.**

Q 24.C

- **The Global Environment Facility (GEF), established on the eve of the 1992 Rio Earth Summit, is a catalyst for action on the environment — and much more. Through its strategic investments, the GEF works with partners to tackle the planet's biggest environmental issues.**
- The GEF is a unique partnership of 18 agencies — including United Nations agencies, multilateral development banks, national entities and international NGOs — working with 183 countries to address the world's most challenging environmental issues. The GEF has a large network of civil society organizations, works closely with the private sector around the world, and receives continuous inputs from an independent evaluation office and a world-class scientific panel.
- It is a financial mechanism for five major international environmental conventions:
  - **The Minamata Convention on Mercury,**
  - **The Stockholm Convention on Persistent Organic Pollutants (POPs),**
  - **The United Nations Convention on Biological Diversity (UNCBD),**
  - **The United Nations Convention to Combat Desertification (UNCCD) and**
  - **The United Nations Framework Convention on Climate Change (UNFCCC). Hence, option (c) is the correct answer.**
- GEF is also an innovator and catalyst that supports multi-stakeholder alliances to preserve threatened ecosystems on land and in the oceans, build greener cities, boost food security and promote clean energy for a more prosperous, climate-resilient world; leveraging $5.2 in additional financing for every $1 invested.
- The GEF Trust Fund was established to help tackle our planet's most pressing environmental problems. Funds are available to developing countries and countries with economies in transition to meet the objectives of the international environmental conventions and agreements.
- **The Montreal Protocol on Substances** that Deplete the Ozone Layer is the landmark multilateral environmental agreement that regulates the production and consumption of nearly 100 man-made chemicals referred to as ozone depleting substances (ODS).
  - 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.
  - The Multilateral Fund's activities are implemented by four international agencies - UN Environment Programme (UNEP) , UN Development Programme (UNDP), UN Industrial Development Organisation (UNIDO) and the World Bank - as well as bilateral agencies of non-Article 5 countries.
  - **The GEF is not formally linked to the Montreal Protocol** but actively supports its implementation.

Q 25.C

- **Density of the population is expressed as the number of persons per unit area.** The density of the population, as discussed in the earlier paragraph, is a crude measure of the human and land relationship. To get a better insight into the human-land ratio in terms of pressure of population on total cultivable land, the physiological and the agricultural densities should be found out which are significant for a country like India having a large agricultural population.
- **Physiological density = total population / net cultivated area**. It is the ratio of total population of an area and the net cultivated area. **Hence statement 1 is correct.**
- Agricultural density = total agricultural population / net cultivable area. This is a ratio of the Total agricultural population and the net cultivable area. **Agricultural population includes cultivators and agricultural labourers and their family members. Hence statement 2 is correct.**

Q 26.C

About the Global Biofuels Alliance (GBA):

- **GBA is an India-led Initiative to develop an alliance of Governments, International organisations and Industry to facilitate adoption of biofuels through international cooperation. Hence statement 1 is correct.**
- **The Global Biofuels Alliance (GBA) was formally launched by the Indian PM on the side-lines of the G20 Summit in New Delhi. Hence statement 2 is correct.**
- GIBA will help create a favourable ecosystem for promoting development and deployment of biofuels with key stakeholders including US, Brazil, EU, IEA etc.
- It will facilitate mobilising a virtual marketplace to assist industries, countries, ecosystem players and key stakeholders in mapping demand and supply, as well as connecting technology providers to end users.

- It will also facilitate development, adoption and implementation of internationally recognised standards, codes, sustainability principles and regulations to incentivize biofuels adoption and trade.

Q 27.D

- **Pachpadra Lake**: Situated in the Barmer district of Rajasthan close to Jaisalmer, **Pachpadra Lake is one of the top saltwater lakes of India**. Besides the usual extraction of high-quality salt from the water, the lake is also a popular tourist spot and one of the most visited attractions in the city.
- **The Tso Kar is one of the top saltwater lakes of India.** It is a fluctuating salt lake regarded for its size and depth situated in the Rupshu Plateau and valley in the southern part of Ladakh in India. Also known as a white lake due to the white salt content in the water deposits on its shore. The lake is 540 km east of Srinagar, the capital of the Jammu and Kashmir union territory
- **Kaliveli Lake**, or Kaliveli Lagoon, is one of the **top saltwater lakes in India**. It is a coastal lake and lagoon with wetlands in the Viluppuram District of Tamil Nadu state.
- **Other Saltwater lakes of India**
    - Fateh Sagar Lake, Udaipur
    - Pulicat Lake
    - Sambhar Lake
    - Chilika Lake
    - Lonar Lake
    - Didwana
- Freshwater Lakes
    - Wular Lake
    - Loktak Lake
    - Kolleru Lake
    - Dhebar Lake
    - Kanwar Lake
- **Hence option (d) is the correct answer.**

Q 28.C

- Water pollution caused by detergents is now a big concern in the global context. The per capita detergent consumption in India is around 2.7 kilogram per year. It is around 3.7 kg in the Philippines and Malaysia and 10 kg in the United States of America.
- **Nonylphenol is commonly used in the production of Nonylphenol Ethoxylates (NPEs). NPEs are used as surfactants as well as in day-to-day consumer products such as detergents, wetting agents and dispersants. It bio-accumulates and can pose serious environmental and health risks. It is a persistent, toxic, bio-accumulative chemical that acts as an endocrine disruptor. Hence, statements 1 and 2 are correct.**
- NPEs enter the environment and ultimately break down to nonylphenols that can enter different environmental matrices such as water and soil. The chemical can also possibly be released during industrial cleaning processes and from wastewater produced during the production of NPEs.
- **It has been detected in human breast milk, blood and urine, and is associated with reproductive and developmental effects in rodents**. It is recommended to find substitutes of nonylphenol. The United Nations Environment Programme (UNEP) has also designated nonylphenol as a chemical of global concern. **Hence, statement 3 is correct.**
- **In India, the Bureau of Indian Standards (BIS) has set standards for phenolic compounds in drinking water (1 ppb) and surface water (5 parts per million (ppm)). However, at present, there are no standards exclusively for nonylphenols in drinking and surface waters in India. Hence, statement 4 is not correct.**

Q 29.C

- Lakes are complex ecosystems that are divided into **different zones based on their depth and light availability**. These zones are:
    - **Littoral zone:** The shallow, nearshore zone of the lake where rooted plants can grow.
    - **Benthic zone:** The bottom layer of the lake, composed of sediments and inhabited by benthic organisms.
    - **Limnetic zone:** The open water zone of the lake, located between the littoral zone and the profundal zone.
    - **Profundal zone:** The deep, cold, and dark zone of the lake, located below the limnetic zone.

- **Phytoplankton Requirements:**
  - Phytoplankton are microscopic algae that are the primary producers in aquatic ecosystems. They require three main conditions to thrive:
    - ✓ **Sunlight:** Phytoplankton are photosynthetic organisms, meaning they use sunlight to convert carbon dioxide and water into organic matter and oxygen.
    - ✓ **Nutrients:** Phytoplankton need nutrients, such as nitrogen, phosphorus, and silicon, to build their cells and carry out photosynthesis.
    - ✓ **Suitable temperature and salinity:** Phytoplankton have optimal temperature and salinity ranges for growth and reproduction.
- **Limnetic Zone Characteristics:**
  - **The limnetic zone is the most suitable zone for phytoplankton growth due to its favorable conditions:**
    - ✓ **Sunlight availability:** The limnetic zone receives sunlight from the surface, providing phytoplankton with the energy they need for photosynthesis.
    - ✓ **Nutrient availability:** Nutrients from the littoral zone and the atmosphere are transported to the limnetic zone through water currents and mixing processes.
    - ✓ **Suitable temperature and salinity:** The limnetic zone typically has a suitable temperature range for phytoplankton growth, and the salinity is relatively low, unlike the profundal zone.
  - **Hence option (c) is the correct answer.**

Q 30.C

- **Allelopathy:**
- Allelopathy is the term used to describe the **chemical interactions between plants that can have either beneficial or harmful effects. Hence option (c) is the correct answer.**
- Plants produce a variety of chemicals, known as allelochemicals, that can be released into the environment through their roots, leaves, or pollen. These allelochemicals can have a variety of effects on other plants, including:
- **Inhibiting growth:** Allelochemicals can inhibit the growth of other plants by interfering with their germination, root development, or nutrient uptake.
- **Stimulating growth:** In some cases, allelochemicals can actually stimulate the growth of other plants. This may be due to the release of nutrients or beneficial hormones.
- **Preventing the establishment of other plants:** Allelochemicals can also prevent the establishment of other plants by making the soil or habitat inhospitable. This can be beneficial for plants, as it reduces competition for resources.

Term	Definition
Allelopathy	Chemical interactions between plants that can have either beneficial or harmful effects
Mutualism	A symbiotic relationship in which both organisms benefit
Parasitism	A symbiotic relationship in which one organism benefits at the expense of the other
Symbiosis	A close and long-term interaction between two or more different species of organisms

Q 31.B

- **Primary Sector**
  - The primary sector involves companies that participate in extracting and harvesting natural products from the Earth. Primary sector companies are typically engaged in economic activity that utilizes the Earth's natural resources, which are sold to consumers or commercial businesses.
  - Companies involved in the processing and packaging of raw materials are also categorized within the primary sector.
  - Primary sector business activities include the following:

- ✓ Mining and quarrying
- ✓ Fishing
- ✓ Agriculture
- ✓ Forestry
- ✓ Hunting

- **Secondary Sector**
  - The secondary sector consists of processing, manufacturing, and construction companies. The secondary sector produces goods from the natural products within the primary sector. The secondary sector includes the following business activities:
    - ✓ Automobile production
    - ✓ **Textile**
    - ✓ Chemical engineering
    - ✓ Aerospace space
    - ✓ **Shipbuilding**
    - ✓ **Energy utilities**
- **Tertiary Sector**
  - The tertiary sector is comprised of companies that provide services, such as retailers, entertainment firms, and financial organizations.
  - The tertiary sector provides services to businesses and consumers by selling the goods that are manufactured by companies in the secondary sector. The types of services provided by the tertiary sector include:
    - ✓ Retail sales
    - ✓ Transportation and distribution
    - ✓ Restaurants
    - ✓ Tourism
    - ✓ Insurance and banking
    - ✓ Healthcare services
    - ✓ Legal services
- **Hence, option (b) is the correct answer.**

Q 32.D

- **Recent Context: JT-60SA, the world's largest and most advanced nuclear fusion reactor started its official operations in Japan's Ibaraki Prefecture.**
- The JT-60SA, **a six-story-high tokamak, is designed to contain and control plasma heated to a staggering 200 million degrees Celsius.**
- **The objective is to explore the viability of fusion as a secure, expansive, and carbon-neutral net energy source, where the energy produced surpasses is more than the input required for its production.**
- This **joint venture between the European Union and Japan serves as a precursor to the International Thermonuclear Experimental Reactor (ITER**) currently under construction in France. Both projects share the ambitious goal of achieving net energy gain from fusion, a milestone that could revolutionize our energy systems. **Hence, option (d) is the correct answer.**
- The experimental nuclear fusion reactor is quite a new technology. However, some say that it is the answer to humanity's future energy needs by establishing nuclear fusion as a clean energy source.
- Unlike traditional nuclear fission used in power plants, which splits atomic nuclei, fusion mimics the sun's energy production by merging two nuclei, potentially offering a safer and more abundant energy source.
- Fusion energy stands out for its safety advantages over fission, as it carries no risk of catastrophic accidents like the Fukushima disaster in 2011 and generates minimal radioactive waste.

Q 33.C

- **Recent Context: Australians recently voted in a referendum to decide whether the country's indigenous peoples should be formally consulted in making laws.** The referendum question read: "A Proposed Law: to alter the Constitution to recognize the First Peoples of Australia by establishing an Aboriginal and Torres Strait Islander Voice. Do you approve this proposed alteration?" **Hence, option (c) is the correct answer.**
- The expression, as well as the word 'aboriginal', refers to the indigenous inhabitants of the continent — people who lived on the Australian mainland and surrounding islands for tens of thousands of years before the first Europeans arrived in the early 17th century.

- The Torres Strait Islands, mentioned in the referendum question, is an archipelago of small islands in the Torres Strait, a narrow body of water between the northern tip of the state of Queensland and the large island of Papua New Guinea.
- **The referendum asks whether indigenous Australians should be recognized in the country's Constitution and whether a body called the indigenous "Voice to Parliament" should be set up to advise lawmakers on matters that impact their lives. The Aboriginals find no mention in Australia's 122-year-old Constitution.**

Q 34.D

- **Recent Context: NASA launched a new sounding rocket to study a stellar event in the Cygnus Loop, which is a supernova remnant that took place 20,000 years ago.**
  - **Cygnus is about 2,600 light years away from the Earth. The sounding rocket mission, named the Integral Field Ultraviolet Spectroscope Experiment (INFUSE) was launched from the White Sands Missile Range in New Mexico. Hence, option (d) is the correct answer.**
- As per astronomers, a massive star, which was perhaps 20 times the size of the sun exploded in a supernova so bright that it was possibly seen from Earth. After this supernova, some matters of the explosion remain suspended in the universe, which is known to astronomers as the Cygnus Loop. The INFUSE mission will study the Cygnus Loop and try to understand the life cycle of stars.
- **The INFUSE mission is expected to collect information about the remnant for a few minutes from a height of 150 miles (240 km). Specifically, the instrument will gather light streaming from the Cygnus Loop in far-ultraviolet wavelengths.**
- The constellation Cygnus (Latin for "swan") used to appear every few months each year in the northern hemisphere's night sky. Just above this constellation exists the favourite spot of professional scientists and backyard astronomers alike- the Cygnus Loop or the Veil Nebula.The Cygnus Loop is the remnant of a star that was once 20 times the size of our Sun. Some 20,000 years ago, that star collapsed under its own gravity and erupted into a supernova. Even from 2,600 light-years away, astronomers estimate the flash of light would have been bright enough to see from Earth during the day.
- As per astronomers and scientists, **supernovae are part of a great life cycle. They spray heavy metals forged in a star's core into the clouds of surrounding dust and gas. They are the source of all chemical elements in our universe heavier than iron, including those that make up our own bodies.**

Q 35.B

- **Ecotype**
  - **An ecotype is a genetically distinct population of a species that is adapted to a specific environment. Hence option (b) is the correct answer.**
  - These adaptations may include genetic, physiological, or behavioral traits that allow the ecotype to thrive in its particular habitat.
  - Ecotypes arise through natural selection, and they represent the local adaptation of a species to its environment.
  - It's important to note that while ecotypes may be genetically distinct, they are still part of the same species.
- **key characteristics of ecotypes:**
  - **Genetic Distinctness:** Ecotypes are genetically distinct from other populations of the same species, indicating a degree of reproductive isolation. This genetic distinction allows ecotypes to maintain their unique adaptations over generations.
  - **Environmental Adaptation**: Ecotypes are adapted to the specific environmental conditions in which they reside. These adaptations can range from physical traits, such as leaf size or shape, to physiological adaptations, such as drought tolerance or salt tolerance.
  - **Geographic Distribution:** Ecotypes are often geographically restricted, occupying specific habitats or regions with distinct environmental conditions. This geographic isolation contributes to their genetic differentiation and adaptation.
  - **Ecological Role:** Ecotypes may play similar or distinct ecological roles within their respective ecosystems. They may fill similar niches or exhibit specialized adaptations that contribute to the overall functioning of the ecosystem.

Q 36.A

- **Harmful algal blooms (HABs)**
  - Harmful algal blooms (HABs) occur when algae — simple photosynthetic organisms that live in the sea and freshwater — grow out of **control while producing toxic or harmful effects on people, fish, shellfish, marine mammals, and birds.**
  - There are many kinds of HABs, caused by a variety of algal groups with different toxins. The HABs in fresh and marine waters are usually very different, but they overlap in low salinity estuaries (places where rivers meet the sea).
  - The human illnesses caused by HABs, though rare, can be debilitating or even fatal. States have rigorous monitoring programs to ensure that commercially harvested fish and shellfish are safe to eat.
  - HABs are a national concern because they affect not only the health of people and marine ecosystems, but also the "health" of local and regional economies.
  - Normal Algal bloom is a rapid increase or accumulation in the population of algae in fresh or marine water, often recognised by the discolouration of water from the algae's pigments. The bloom consists of phytoplankton or free-floating microscopic algae. **The algal bloom caused Toxic phtoplankton are reffered as HABs. They can occur in Fresh water, Marine Water or Brackish Water. Hence statement 2 is not correct.**
  - On their own, algae and cyanobacteria are not good or bad. They are organisms that are important to the earth because they produce the oxygen needed to sustain life. However, if too much algae or cyanobacteria grow at once or if they make toxins, they can harm people, animals, and the environment. Not all phytoplankton are harmful **but the toxic ones are referred to as harmful algal blooms. In other words the toxic phytoplanktons which cause Algal booms are called as HABs. Hence statement 1 is not correct.**
  - **HABs kill water organisms, especially fish, by causing oxygen depletion.** Even after the bloom dies, the microbes that decompose the dead algae use up oxygen, causing fish to suffocate. **Hence statement 3 is correct.**

Q 37.B

- A new study called "Measuring Underwater Noise Levels Radiated by Ships in Indian Waters" has found that the increasing levels of underwater noise emissions (UNE) from ships in Indian waters are endangering the marine ecosystem.
- **Marine sound pollution refers to excessive or harmful sound released into the ocean environment due to various human activities, including shipping, military sonar, oil and gas exploration, and recreational activities like boating and jet skiing. Hence, statement 1 is correct.**
- This type of pollution can negatively impact marine life in several ways. It can interfere with the communication, navigation, and hunting behaviors of marine mammals, such as whales, dolphins, and porpoises.
- The study found that the sound pressure levels of UNE in Indian waters are reaching between 102-115 decibels, relative to one microPascal, which is significantly higher on the East Coast than the West. Scientists use 1µPa as the reference pressure for underwater sound.
- Continuous shipping movement has been identified as a significant contributor to the increase in global ocean noise levels. UNE is threatening the lives of marine mammals, such as bottlenose dolphins, manatees, pilot whales, seals, and sperm whales. These species rely on sound as the primary form of energy for multiple behavioral activities, including mating, communal interaction, feeding, cluster cohesion, and foraging.
- The frequencies of ships' underwater self-noise and machinery vibration levels overlap with the marine species' communication frequencies in the low-frequency range of less than 500 Hz. **This overlapping is called masking, which may lead to a change in the migration route of marine species to the shallow regions, making it difficult for them to return to deeper water.** Moreover, the sound that radiates from ships on a long-term basis affects marine species, resulting in internal injuries, loss of hearing ability, change in behavioral responses, masking, and stress. **Hence, statement 2 is correct.**
- **The National Institute of Ocean Technology (NIOT) under MoES** collects information about underwater noise levels in Indian seas. An autonomous noise measurement system has been developed and deployed in Indian seas for monitoring the man-made Underwater Noise Emissions (UNE). **However, the issue of underwater noise pollution is neither addressed in the Deep Sea Mission nor the National Policy for Blue Economy. Hence, statements 3 and 4 are not correct.**

Q 38.C

- **Thwaites Glacier**
  - **Thwaites Glacier, also known as the Doomsday Glacier, is an immense glacier located in West Antarctica.** It is the world's widest glacier, spanning approximately 120 miles (190 kilometers), and is one of the fastest-melting glaciers on Earth. Thwaites Glacier is considered a critical component of the Antarctic Ice Sheet, and its collapse could have a significant impact on global sea levels. **Hence pair 1 is correctly matched.**
- **The Steenstrup Glacier**
  - **The Steenstrup Glacier is a large glacier located in Northwest Greenland.** It is one of the fastest-melting glaciers in Greenland and is responsible for a significant portion of the island's ice loss. The glacier is located in a particularly vulnerable region of Greenland, and its melting is expected to accelerate in the coming decades. **Hence pair 2 is correctly matched.**
- **Schlatenkees**
  - **Schlatenkees is a glacier located in the Austrian Alps.** It is one of the most studied glaciers in the world and has been closely monitored for decades. Schlatenkees has been **retreating at an alarming rate in recent years,** and its decline is considered a bellwether for the health of glaciers in the region. **Hence pair 3 is correctly matched.**

Q 39.A

- Solar power projects can be set up anywhere in the country, however, the solar power projects developed in a scattered manner lead to higher project cost per MW and higher transmission losses. Individual projects of smaller capacity incur significant expenses in site development, drawing separate transmission lines to nearest substation, procuring water and in creating of other necessary infrastructure. It also takes longer time for project developers to acquire land, get all types of clearances and permissions, etc. which ultimately delays the project.
- **To overcome these challenges, the scheme for "Development of Solar Parks and Ultra-Mega Solar Power Projects" was rolled out in December 2014 with the objective of facilitating the solar project developers to set up projects expeditiously. Under this scheme, the Government has sanctioned 50 Solar Parks with an aggregate capacity of 37,990 MW in 12 States across the country, so far.** Against this sanction, 11 Solar Parks with an aggregate capacity of 8521 MW have been completed and 7 Solar Parks with an aggregate capacity of 3985 MW have been partially completed. In these parks, solar projects of an aggregate capacity of 10,237 MW have been developed. **Hence, statement 1 is not correct.**
- **Salient features**:
  - The scheme envisages supporting the States/UTs in setting up solar parks at various locations in the country with a view to creating the required infrastructure for setting up of solar power projects. The solar parks provide suitable developed land with all clearances, transmission systems, water access, road connectivity, communication networks, etc. The scheme facilitates and speeds up the installation of grid-connected solar power projects for electricity generation on a large scale.
  - All the States and Union Territories are eligible for getting benefits under the scheme.
  - The capacity of the solar parks shall be 500 MW and above. However, smaller parks are also considered where contiguous land may be difficult to acquire in view of difficult terrain and where there is an acute shortage of non-agricultural land.
  - **The Solar Parks are developed in collaboration with the State Governments and their agencies, CPSUs, and private entrepreneurs. The implementing agency is termed as Solar Power Park Developer (SPPD). There are 8 modes for selection of SPPDs. Solar Energy Corporation of India (SECI) acts as a nodal agency for the scheme. Hence, statement 2 is correct.**
- **Recently, the Union Ministry of New and Renewable Energy has extended the scheme for 'Development of Solar Parks and Ultra Mega Solar Park Projects' till FY26 because of delays in implementation. The reasons for the delay in establishing solar parks include challenges in the acquisition of clear land, mismatch in timelines between solar projects and power evacuation infrastructure, environmental issues like the Great Indian Bustard (GIB) issue, regulatory challenges like non-approval of solar tariff by SERCs, etc. Hence, statement 3 is not correct.**

Q 40.A

- Earlier, noise pollution and its sources were addressed under the Air (Prevention and Control of Pollution) Act, 1981. **They are now, however, regulated separately under the Noise Pollution (Regulation and Control) Rules, 2000 prescribed under the purview of Environment (Protection) Act, 1986. Hence, statement 1 is not correct.**

- According to the rules, a loudspeaker or a public address system shall not be used except after obtaining written permission from the authority.**A loudspeaker or a public address system shall not be used at night (between 10:00 p.m. to 6:00 a.m.) except in closed premises for communication within, e.g. auditoria, conference rooms, community halls and banquet halls. Hence, statement 3 is correct.**
- Noise emanating from industry is regulated by State Pollution Control Boards / Pollution Control Committees (SPCBs / PCCs) for states / Union territories under the Air (Prevention and Control of Pollution) Act, 1981. **Hence, statement 2 is not correct.**

Q 41.B

- **Trophic cascade:**
  - Trophic cascades are a fundamental concept in ecology that describes the **far-reaching consequences of changes in predator-prey relationships within a food web**.
  - These indirect effects can ripple through multiple trophic levels, influencing the abundance and behavior of organisms across the entire ecosystem. **Hence option (b) is the correct answer.**
  - A trophic cascade is initiated by a change in the population of a predator or prey species, either through natural processes like predation, disease, or environmental changes, or through human interventions like hunting, fishing, or the introduction of non-native species.
  - This initial change can trigger a chain reaction of ecological effects as organisms at different trophic levels respond to the altered predator-prey dynamics.
  - **Example:**
    - ✓ For instance, if a top predator, such as a wolf, is removed from an ecosystem, its primary prey, such as deer, may experience a population explosion. This increase in deer herbivory can have a cascading impact on the vegetation community, leading to reduced plant diversity and changes in ecosystem structure.
  - **Factors affecting Trophic Cascade:**
    - ✓ The strength and direction of trophic cascades can vary depending on the characteristics of the food web, the species involved, and the environmental conditions. In some cases, the effects can be dramatic and long-lasting, while in others, they may be subtle and short-lived.
  - **Function of Trophic Cascade:**
    - ✓ Trophic cascades play a crucial role in maintaining the stability and resilience of ecosystems. They help regulate populations, control the spread of diseases, and influence the distribution of resources. Understanding trophic cascades is essential for managing ecosystems sustainably and conserving biodiversity.

Q 42.D

Wildlife (Protection) Act, 1972:

- The Act was enacted for the protection of plants and animal species. Prior to this legislation, India had only five designated national parks.
- **Salient Features Of The Act**
  - Prohibition of hunting: It prohibits the hunting of any wild animal specified in Schedules I, II, III, and IV of the act.
  - Prohibition of Cutting/Uprooting Specified Plants: It prohibits the uprooting, damage, collection, possession, or selling of any specified plant from any forest land or any protected area.
  - Exception: The CWLW, however, may grant permission for uprooting or collecting a specific plant for the purpose of education, scientific research, preservation in a herbarium, or if a person/institution is approved to do so by the central government.

National Board for Wildlife (NBWL):

- As per the act, the central government of India shall constitute the National Board for Wildlife (NBWL).It serves as an apex body for the review of all wildlife-related matters and for the approval of projects in and around national parks and sanctuaries.
- The board is 'advisory' in nature and can only advise the Government on policymaking for the conservation of wildlife.

State Board for Wildlife (SBWL):

- The state governments are responsible for the constitution of the state board of wildlife. The Chief Minister of the state/UT is the chairperson of the board.

Central Zoo Authority:

- The act provides for the constitution of Central Zoo Authority consisting of a total of 10 members including the Chairperson and a Member-Secretary. The Environment Minister is the chairperson.
- The authority provides recognition to zoos and is also tasked with regulating the zoos across the country. It lays down guidelines and prescribes rules under which animals may be transferred among zoos nationally and internationally.

National Tiger Conservation Authority (NTCA):

- **It was constituted under enabling provisions of the Wildlife (Protection) Act, 1972, as amended in 2006, for strengthening tiger conservation, as per powers and functions assigned to it. The Union Environment Minister is the Chairperson of NTCA and the State Environment Minister is the Vice-Chairperson.**
- The Central Government on the recommendations of NTCA declares an area as a Tiger Reserve. More than 50 wildlife sanctuaries in India have been designated as Tiger Reserves and are protected areas under the Wildlife Protection Act, 1972.

Wildlife Crime Control Bureau

- It is a statutory multi-disciplinary body established by the Government of India under the Ministry of Environment and Forests, to combat organized wildlife crime in the country.
- Under Section 38 (Z) of the Wild Life (Protection) Act, 1972, it is mandated to collect and collate intelligence related to organized wildlife crime activities and to disseminate the same to State and other enforcement agencies for immediate action so as to apprehend the criminals; to establish a centralized wildlife crime data bank; co-ordinate actions by various agencies in connection with the enforcement of the provisions of the Act.

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

Q 43.C

- **The Pacific Decadal Oscillation** is a sea surface temperature (SST) climate cycle describing **sea surface temperature anomalies over the Northeastern Pacific Ocean**. As its name suggests the SSTs associated with the PDO exhibit decadal variability. The PDO can influence the weather conditions across the globe.
- The Pacific Decadal Oscillation (PDO) is a **long-term climate pattern that affects the temperature of the Pacific Ocean** and the weather patterns around it. The PDO is a naturally occurring phenomenon that shifts between warm and cool phases, with each phase lasting around **20-30 years**. **Hence statement 1 is not correct.**
- During the positive phase, the central and eastern Pacific Ocean experiences **warmer-than-average sea surface temperatures.** In the **negative phase,** the **central and eastern Pacific Ocean experiences cooler-than-average** sea surface temperatures. **Hence statement 2 is correct.**
- **Negative phases** could be linked to **times of slower warming.** This is because cold phases of the PDO tend to **increase mixing of colder, deep ocean waters** with warmer surface waters. This temporarily reduces the rate of global warming caused by increasing greenhouse gas emissions. **Positive phases have the opposite effect. Hence statement 3 is correct.**
- During the **positive phase of the PDO** in the northern hemisphere **wintertime**, the characteristic atmospheric circulation patterns tend to bring **cooler-than-normal conditions to much of Asia.** This is often associated with a **weakened Siberian High**, allowing for milder and drier conditions in northern regions of Asia. The altered atmospheric circulation associated with the positive PDO can contribute to a **milder and less harsh winter** in the Indian subcontinent with **above normal temperatures. Hence statement 4 is correct.**

Q 44.A

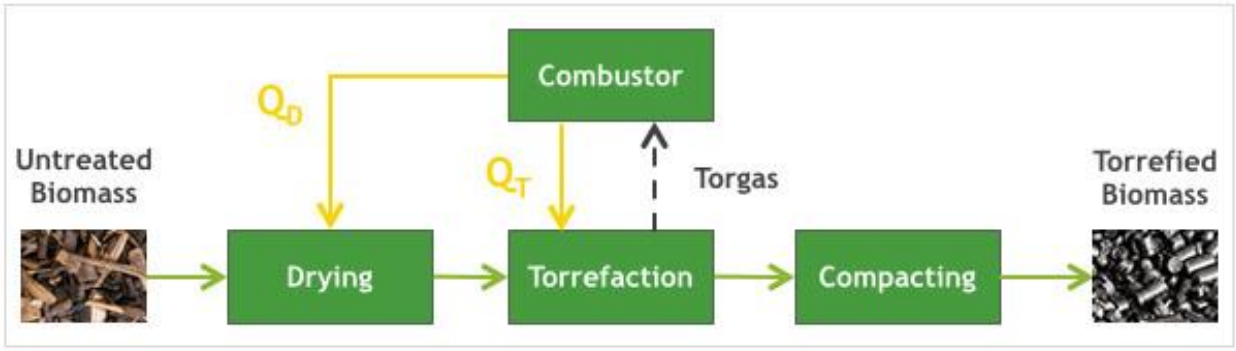
- **Recent Context: Recently, the UN Secretary-General Antonio Guterres invoked Article 99, a rarely used provision of the UN Charter, to bring to the attention of the Security Council "hostilities in Gaza and Israel' as he believes it 'may aggravate existing threats to international peace and security". Hence option (a) is the correct answer.**
- This decision is aimed at formally warning the UN Security Council about the global threat emanating from Israel's ongoing military operations in Gaza. Guterres has been urging an "immediate humanitarian ceasefire" since October 18, but the Security Council has yet to adopt a resolution due to differences among its permanent members.

- **Though Article 99 does not immediately result in direct action from the UN or the Security Council**, it could present the Security Council with an impetus to revisit previously failed draft resolutions regarding the situation in Gaza, including one that would have called for a ceasefire, if not for a U.S. veto.
- **Article 99 provides UN Secretary General a special power and only independent tool available to him under the UN charter. By invoking Article 99, Guterres gains the right to speak at the Security Council without the need for an invitation from a member state.**
- **Article 99 grants the Secretary-General the authority to bring attention to threats, but it does not confer the power to force the Security Council to adopt specific resolutions**.
- **The Security Council, as the UN's most powerful body, has the responsibility to maintain international peace and security. I**f the council chooses to act on Guterres's advice and adopts a ceasefire resolution, it gains additional powers to ensure implementation.
- These powers include the **authority to impose sanctions or authorize the deployment of an international force**. However, Article 99 does not provide Guterres with the means to compel the Security Council to adopt resolutions. The veto power held by the five permanent members—China, Russia, the United States, the United Kingdom, and France—poses a significant challenge.

Q 45.C

- Pollution from stubble burning in winter is the key contributor to the sharp decline in air quality in Delhi. But stubble burning continues unabated. To find a solution to this issue, India is testing a Swedish technology — torrefaction that can convert rice stubble into 'bio-coal.
- Torrefaction is the thermochemical conversion of biomass in an oxygen-free environment. It generates a solid material with increased energy density and carbon content. **Hence, option (c) is the correct answer.**
- The technology involves heating up straw, grass, saw mill residue and wood biomass to 250 degrees Celsius - 350 degrees Celsius. This changes the elements of the biomass into 'coal-like' pellets. These pellets can be used for combustion along with coal for industrial applications like steel and cement production. This technology can convert about 65% of the biomass into energy.
- Torrefaction of biomass results in a high grade biofuel which can be used as a replacement of coal in electricity and heat production. Torrefied biomass can also be used as input for gasification processes in the production of high value biobased fuels and chemicals.

BASIC TORREFACTION PRINCIPLE



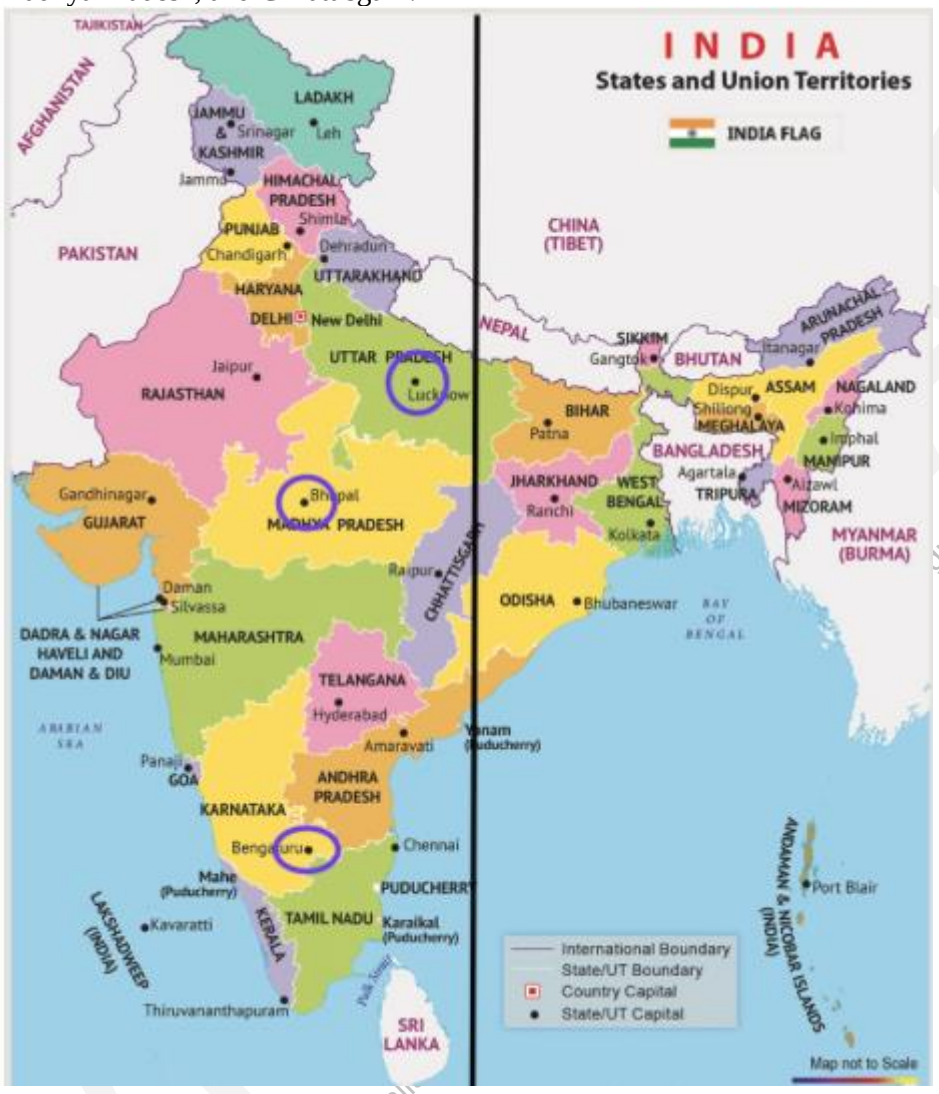
Q 46.C

- Within the past 50 years, eutrophication — the over-enrichment of water by nutrients such as nitrogen and phosphorus — has emerged as one of the leading causes of water quality impairment. **The two most acute symptoms of eutrophication are hypoxia (or oxygen depletion) and harmful algal blooms, which among other things can destroy aquatic life in affected areas.**
- Excess nutrients in coastal waters can cause excessive growth of phytoplankton, microalgae (i.e. epiphytes and microphytes), and macroalgae (i.e. seaweed). In turn, the increase in phytoplankton and algae can lead to more severe secondary impacts such as:
  - **Loss of subaquatic vegetation as excessive phytoplankton, microalgae and macroalgae growth reduce light penetration.**
  - **Change in species composition and biomass of the benthic (bottom-dwelling) aquatic community, eventually leading to reduced species diversity and the dominance of gelatinous organisms such as jellyfish.**
  - Coral reef damage as increased nutrient levels favor algae growth over coral larvae. Coral growth is inhibited because the algae outcompete coral larvae for available surfaces to grow.

- A shift in phytoplankton species composition, creating favorable conditions for the development of nuisance, toxic, or otherwise harmful algal blooms. **Low dissolved oxygen and the formation of hypoxic or "dead" zones (oxygen-depleted waters), which in turn can lead to ecosystem collapse. Hence, option (c) is the correct answer.**

Q 47.C

- The standard meridian of India is 82.5 degrees east longitude. It is ahead by 5 hours 30 minutes from the Greenwich Meridian Time (GMT). It passes through Allahabad.
- In India, the standard meridian passes through the states of Uttar Pradesh, Orissa, Andhra Pradesh, Madhya Pradesh, and Chhattisgarh.



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

Q 48.C

- The National Green Tribunal, established in 2010, as per the National Green Tribunal Act is a specialised judicial body equipped with expertise solely for the purpose of adjudicating environmental cases in the country.
- Recognizing that most environmental cases involve multi-disciplinary issues which are better addressed in a specialized forum, the Tribunal was set up as per recommendations of the Supreme Court, Law Commission and India's international law obligations to develop national laws on the environment and implement them effectively.
- The Tribunal is tasked with providing effective and expeditious remedies in cases relating to environmental protection, conservation of forests and other natural resources and enforcement of any legal right relating to the environment. The Tribunal's orders are binding and it has the power to grant relief in the form of compensation and damages to affected persons.
- Any person seeking relief and compensation for environmental damage involving subjects in the legislations mentioned in Schedule I of the National Green Tribunal Act, 2010 may approach the Tribunal.

- The statutes in Schedule I are:
  - **The Water (Prevention and Control of Pollution) Act, 1974;**
  - **The Water (Prevention and Control of Pollution) Cess Act, 1977;**
  - **The Forest (Conservation) Act, 1980;**
  - **The Air (Prevention and Control of Pollution) Act, 1981;**
  - **The Environment (Protection) Act, 1986;**
  - **The Public Liability Insurance Act, 1991;**
  - **The Biological Diversity Act, 2002. Hence, option (c) is the correct answer.**
- The Tribunal has jurisdiction over all civil cases involving a substantial question relating to the environment and the question. Additionally, any person aggrieved by an order/direction of any of the Appellate Authorities under the legislations mentioned above can also challenge them before the National Green Tribunal.

Q 49.B

- India communicated its Intended Nationally Determined Contributions (INDCs) to the United Nations Framework Convention on Climate Change (UNFCCC) committing amongst others, mainly to reduce the emissions intensity of its GDP by 33 to 35 percent by 2030 from 2005 level and to achieve about 40 percent cumulative electric power installed capacity from non-fossil fuel based energy resources by 2030.These initiatives at both international and national levels have proved to be a major motivation for energy security and reduced dependence on conventional sources of fuel. It can be a step towards meeting the INDCs, thereby contributing to the global effort to meet the challenges of climate change.
- **Pursuant to the enactment of the Electricity Act 2003, the SERCs are required to fix a minimum percentage of the total consumption of electricity in the area of a distribution licensee for the purchase of energy from renewable energy sources. With the amendment of Tariff Policy in January 2016, the State Electricity Regulatory Commissions (SERCs) are required to reserve a minimum percentage for purchase of solar energy which shall be such that it reaches 8% of total consumption of energy, excluding Hydro Power, by March 2022 or as notified by the Central Government from time to time. The Government of India in July, 2018 notified the Long Term growth trajectory of Renewable Purchase Obligations (RPOs) for Solar as well as Non-solar, uniformly for all States/ Union Territories, reaching 21% of RPO by 2022 with 10.5% for solar-based electricity. Hence, statement 1 is not correct.**
- Under Section 86(1) (e) of the Electricity Act 2003 ("EA 2003") and the National Tariff Policy 2006, Renewable purchase obligation (RPO), is a mechanism by which the obligated entities are obliged to purchase a certain percentage of electricity from Renewable Energy sources, as a percentage of the total consumption of electricity. RPOs are categorized as Solar and Non-Solar RPOs. **The RPO targets specified for solar and non-solar power are to be adhered and met uniformly by the Obligated Entities of all the States and Union Territories. Obligated Entities (which includes Discoms, Open Access Consumers and Captive power producers) are obligated to purchase a minimum share of their electricity from renewable energy sources as per RPO targets. Hence, statement 2 is correct.**

Q 50.A

- **Recent Context: The 'Chief Economists Outlook' report, which was released recently by the World Economic Forum,** aims to provide a brief overview of the current economic situation and highlight key areas where policymakers and business leaders should focus their efforts in response to the shocks caused by geo-economic and geopolitical events. **Hence option (a) is the correct answer.**
- **Highlights of Report:**
  - Six in 10 economists surveyed have warned of a deepening trade-off between development and climate action. 2023 marks the halfway point to the 2030 deadline for the United Nations' Sustainable Development Goals (SDGs).
  - The report, also finds that over 60% of chief economists expect the global economy to weaken in the coming year amid uncertain domestic and international politics and unsettled financial markets.
  - Although a large majority (86%) expects the recent global inflationary surge to ease, the prolonged tightening of financial conditions is expected to have lasting impacts, including a squeeze on business lending, increases in corporate debt defaults, and potential corrections in property and equity markets.
  - Developing countries face the most acute effects of these global headwinds, with chief economists warning that progress towards global development goals could be undermined by geopolitical tensions (74%) and tighter financial conditions (59%).
  - A minority of chief economists expect increased cooperation (41%) and private capital flows (30%) between advanced and developing countries over the next three years.

- **World Economic Forum:**
  - The World Economic Forum (WEF) is a Swiss **nonprofit foundation established in 1971, based in Geneva, Switzerland.**It is recognized by the Swiss authorities as the international institution for public-private cooperation.
  - **Mission**: Committed to improving the state of the world by engaging business, political, academic, and other leaders of society to shape global, regional, and industry agendas.
  - **Other major reports published by WEF are**:
    - ✓ Energy Transition Index.
    - ✓ Global Competitiveness Report.
    - ✓ Global IT Report.
    - ✓ Global Gender Gap Report.
    - ✓ Global Risk Report.
    - ✓ Global Travel and Tourism Report.

Q 51.A

- The **Earth's magnetic field** is a product of the **dynamic motion of molten iron and nickel in the planet's outer core**, generating electric currents and, consequently, a **magnetic field.** This field, analogous to that of a bar magnet, has distinct **north and south poles**, though not perfectly aligned with the geographic poles.
- **Paleomagnetism is a branch of geophysics that investigates the Earth's historical magnetic field** by examining the **magnetic properties preserved in rocks and minerals**. This discipline relies on the principle that certain minerals align with the Earth's magnetic field during their formation.
- when molten hot lavas come up with the rising thermal convection current along the mid-oceanic ridges and get cooled and solidified, th**ese (lavas) also get magnetized**, at the same time**, in accordance with the geomagnetic field and thus alternate bands or stripes of magnetic anomalies are formed on either side of the mid-oceanic ridge.**
- when molten lavas are upwelling along the mid-oceanic ridges, these divide the earlier basaltic layer into two equal halves and these basaltic layers slide horizontally on **either side of the mid-oceanic ridges. Hence statement 1 is correct.**
- There is **a reversal in the main magnetic field of the earth** (known as the geocentric dipole magnetic field). Normal and reverse magnetic anomalies are found in an alternate manner on either side of the mid-oceanic ridges. **There is complete parallelism in the magnetic anomalies** on either side of the mid-oceanic ridges and there is parallelism in the time sequence of paleomagnetic epochs. **Hence statement 2 is correct and correct explanation for statement 1.**
- **Hence option (a) is the correct answer.**

Q 52.C

- **Food chains :**
  - Food chains represent the transfer of energy and nutrients from primary producers to consumers in an ecosystem. They are interconnected and play a vital role in maintaining the overall balance and stability of the ecosystem. However, various factors can disrupt the stability of food chains and lead to cascading effects throughout the ecosystem.
- **Factors affecting Food Chains:**
  - **The introduction of an invasive species:**
    - ✓ The introduction of a new species, particularly an invasive or non-native species, can significantly impact the stability of a food chain. Invasive species may compete with native species for resources, prey on native species, or introduce new diseases. For example, the introduction of the zebra mussel in the Great Lakes disrupted the food chain by outcompeting native mussels and altering the nutrient balance of the ecosystem. **Hence statement 1 is correct.**
  - **Changes in environmental conditions:**
    - ✓ Environmental changes, such as fluctuations in temperature, precipitation, or other abiotic factors, can also impact the stability of food chains. These changes can affect the abundance, distribution, and behavior of organisms, altering their interactions within the food chain. For instance, prolonged drought can reduce the availability of plant matter, impacting herbivores and higher-level consumers. **Hence statement 2 is correct.**
  - **The removal of a keystone species:**
    - ✓ The removal of a keystone species, a species that plays a disproportionately important role in maintaining the structure and function of an ecosystem, can have severe consequences for food

chain stability. Keystone species often have strong interactions with other species, and their removal can lead to cascading effects throughout the food chain. For example, the removal of sea otters from kelp forests resulted in overgrazing by sea urchins, ultimately destroying the kelp forest ecosystem. **Hence statement 3 is correct.**

- **Habitat destruction and fragmentation:**
  - ✓ When habitats are destroyed or fragmented, it can reduce the available space and resources for organisms, leading to changes in population sizes, predator-prey dynamics, and the overall structure of the food chain. For instance, deforestation can harm primary producers and the organisms that depend on them, disrupting the flow of energy through the food chain.
- **Pollution and contamination:**
  - ✓ Various forms of pollution, such as chemical pollutants, agricultural runoff, and industrial waste, can harm organisms at all levels of the food chain. These pollutants can accumulate in organisms' bodies, causing health problems, reducing reproductive success, and altering their interactions within the food chain.
- **Human exploitation and overharvesting:**
  - ✓ Overharvesting of certain species for food, medicine, or other purposes can disrupt the balance of the food chain. For example, overfishing can deplete populations of fish, affecting the predators that rely on them for prey and ultimately impacting the entire ecosystem.
- **Climate change and global warming:**
  - ✓ Climate change is causing shifts in temperature, precipitation patterns, and ocean acidification, which can have profound effects on food chains. These changes can alter the distribution and abundance of organisms, disrupt their life cycles, and lead to shifts in predator-prey dynamics.
- **Diseases and parasites**:
  - ✓ Diseases and parasites can spread throughout food chains, causing mortality, reducing reproductive success, and altering the behavior of organisms. For instance, the spread of disease among herbivores can have cascading effects on carnivores and other organisms that depend on them for food.

Q 53.B

- **United Nations Population Fund:**
  - It is a subsidiary organ of the UN General Assembly and works as a sexual and reproductive health agency.
  - **The UN Economic and Social Council (ECOSOC) establishes its mandate. Hence, statement 3 is correct.**
  - It was established as a trust fund in 1967 and began operations in 1969.
  - In 1987, it was officially renamed the United Nations Population Fund but the original abbreviation, 'UNFPA' for the United Nations Fund for Population Activities was retained.
  - Aim:
    - ✓ UNFPA works for Sustainable Development Goals on health (SDG3), education (SDG4) and gender equality (SDG5).
    - ✓ **Our goal is to end the unmet need for family planning, preventable maternal death, and gender-based violence and harmful practices including child marriage and female genital mutilation by 2030. Hence, statement 1 is correct.**
  - **UNFPA is entirely supported by voluntary contributions of donor governments, intergovernmental organizations, the private sector and foundations and individuals, not by the United Nations' regular budget. Hence, statement 2 is not correct.**
- **Hence, option (b) is the correct answer.**

Q 54.B

- **The Food and Agriculture Organization of the United Nations (FAO) and the SEED partnership officially launched the SDG Agrifood Accelerator Programme,** an instrument designed to help agrifood system start-ups develop their businesses while contributing to the UN's Sustainable Development Goals (SDGs). **Hence, statement 1 is not correct.**
- **The Programme supports select small and medium-sized enterprises from developing countries, that are pioneering solutions to transform agrifood systems through enhancing environmental protections and improving the lives of marginalized members of their communities. It provides the agrifood innovators involved with tailored coaching and a toolkit of resources to help scale-up their business and accelerate action towards the SDGs. Hence, statement 2 is correct.**

- The SDG Agrifood Accelerator Programme acknowledges that all 17 SDGs are interconnected and addresses challenges across a broad range of goals, from no poverty and zero hunger to good health, gender equality and climate action.
- Operating across eight countries in Africa and Asia, the 12 SMEs who joined the Programme have been pioneering solutions designed to transform agrifood systems while improving the lives of some of the most vulnerable people in their communities.
- The SDG Agrifood Accelerator Programme provides a new model for supporting agrifood systems transformation through the development of scalable and replicable business instruments, which support enterprises to go digital and to reach their economic targets, while contributing to accelerating SDG implementation in their local context.

Q 55.C

- **What is soil respiration?**
  - **Soil respiration is the process by which carbon dioxide (CO2) is released from the soil. This process is carried out by soil microbes, which decompose soil organic matter (SOM) and plant litter.** SOM is a complex mixture of organic compounds that is formed from the remains of plants and animals. Plant litter is made up of dead plant material, such as leaves, stems, and roots. **Hence statement 1 is correct.**
- **Why is soil respiration important?**
  - Soil respiration is an important part of the global carbon cycle. It is one of the main ways that CO2 is released into the atmosphere. Soil respiration rates are also an important indicator of soil health. **Healthy soils have high rates of soil respiration,** which indicates that there is a lot of microbial activity in the soil. This microbial activity is essential for the decomposition of SOM and plant litter, and it also helps to release nutrients into the soil that plants can use.
- **What factors affect soil respiration?**
  There are a number of factors that can affect soil respiration rates, including:
  - **Soil temperature:** Soil respiration rates increase with increasing soil temperature. **Warmer temperatures increase the activity of soil microbes, which leads to an increase in the rate of soil respiration. Colder temperatures decrease the activity of soil microbes, which leads to a decrease in the rate of soil respiration. Hence statement 2 is correct.**
  - **Soil moisture:** Soil respiration rates also increase with increasing soil moisture. However, if the soil is too wet, the lack of oxygen can limit microbial activity and reduce soil respiration rates.
  - **Soil organic matter (SOM) content:** Soils with higher SOM content tend to have higher soil respiration rates. This is because there is more organic material available for soil microbes to decompose.
  - **Plant litter input:** Soils with higher rates of plant litter input tend to have higher soil respiration rates. This is because there is more organic material available for soil microbes to decompose.
  - **Nutrient availability:** Soil respiration rates can also be affected by nutrient availability. Nutrients, such as nitrogen and phosphorus, are essential for microbial growth, and they can limit soil respiration rates if they are not available in sufficient quantities.
- **How does soil respiration affect climate change?**
  - Soil respiration is a major source of CO2 emissions to the atmosphere. CO2 is a greenhouse gas, which means that it traps heat in the atmosphere. This trapped heat contributes to global warming. As the Earth's climate warms, soil respiration rates are expected to increase. This will release more CO2 into the atmosphere and further contribute to global warming.
- **What can be done to reduce soil respiration rates?**
  There are a number of things that can be done to reduce soil respiration rates, including:
  - **Reducing soil tillage:** Tillage can disrupt soil structure and reduce SOM content, which can lead to increased soil respiration rates.
    Increasing plant litter input: Plant litter provides a source of organic material for soil microbes to decompose. Increasing plant litter input can help to reduce soil respiration rates.
  - **Managing soil moisture:** Maintaining optimal soil moisture levels can help to reduce soil respiration rates.
    Adding nutrients to the soil: Adding nutrients to the soil can help to increase microbial activity and reduce soil respiration rates.

Q 56.D

- **Tuareg, North Africa**
  - The Tuareg people primarily inhabit the Sahara Desert in North Africa, particularly in countries like Mali, Niger, and Algeria. One of the most distinctive features of the Tuareg people is their blue clothing. **Hence, pair 1 is correctly matched.**
- **Ayoreo, Paraguay**
  - Ayoreo people live in isolation within the Chaco, South America's largest forest outside of the Amazon, they could probably be the last uncontacted indigenous group on the continent, apart from those within the Amazon basin. **Hence, pair 2 is correctly matched.**
- **Kawahiva, Brazil**
  - Also known as the 'short people' or the 'redhead people' by nearby tribes, Kawahiva people have probably been compelled to adopt a nomadic way of life in recent decades due to deforestation in Brazil's Amazon rainforest. **Hence, pair 3 is correctly matched.**
- **Sentinelese, India**
  - Often dubbed as the world's most isolated community, the Sentinelese are also known as highly reclusive inhabitants because of their violent resistance to outsiders. These people, commonly referred to as the Sentinelese or North Sentinel Islanders, remain a linguistic enigma, with an unknown native language even to related Andaman tribes on nearby islands. **Hence, pair 4 is correctly matched.**
- **Hence, option (d) is the correct answer.**

Q 57.A

- **Recent Context: India has been unanimously elected as a member representing the Asian region in the executive committee of the Codex Alimentarius Commission (CAC), the food safety and quality standard-setting body created by the UN, at its meeting in Rome.**
- **CAC is an international food standards, guidelines and codes of practice contribute to the safety, quality and fairness of this international food trade.** Consumers can trust the safety and quality of the food products they buy and importers can trust that the food they ordered will be in accordance with their specifications. **Hence, statement 1 is correct.**
- **The Codex Alimentarius commission was created by the Food and Agriculture Organization of the United Nations and World Health Organization. Hence, statement 2 is not correct.**
- **India's proposal for setting up group standards for millets was also accepted by the Commission** and India's initiative for establishing global standards for millets was acknowledged by the Commission and supported by the member countries.
- India has framed a comprehensive group standard for 15 types of millets specifying 8 quality parameters, which received resounding applause at the international meet. Codex currently has standards for Sorghum and Pearl Millet.
- India put forward a proposal for the development of global standards for millets, particularly for Finger millet, Barnyard millet, Kodo millet, Proso millet and Little millet as group standards as in case of pulses. The proposal was unanimously endorsed in the session at FAO Headquarters in Rome, which is being attended by representatives from 161 member countries, including the European Union (EU).

Q 58.A

- **Tropical Dry Evergreen Forests: occur along the coasts of Tamil Nadu and are areas that receive an annual rainfall of about 100 cm mostly from the northeast monsoon winds in October-December. Hence statement 1 is not correct.**
- Here, the mean annual temperature is about 28°C and the mean humidity is about 75 percent. These areas are covered by the tropical dry evergreen forests.
- The growth of evergreen forests in areas of such low rainfall arouses great botanical interest, and the reason for such a phenomenon is difficult to explain. It may be due to the seasonal distribution of rainfall. Most of the rainfall occurs in winter.
- **The chief characteristics of these forests are short-statured trees, up to 12 m high**, with complete canopy, mostly of coriaceous leaved trees of short boles, no canopy layer differentiation, **bamboos are rare or absent, and grasses not conspicuous. Hence statement 2 is correct and statement 3 is not correct.**
- The important species are khirni, jamun, kokko, ritha, tamarind, neem, machkund, toddypaln, gamari canes, etc. Most of the land under these forests has been cleared for agriculture or casuarina plantations.

Q 59.A

- **The established metric under the 2015 Paris Agreement for measuring the global warming potential of a gas over a 100-year period is GWP100, which is the global warming potential evaluated over a 100-year timeline. It focuses on the absolute level of emissions. GWP100 is the internationally accepted standard and is used by countries for their emissions accounting, as agreed at the United Nations level. However, when using a blanket calculation such as GWP100 we need to be mindful of its limitations when making decisions around short-lived gases. Hence, statement 1 is correct but statement 2 is not correct.**
- The aim of GWP is to allow nations to see which activities are the biggest contributors to global warming across the various greenhouse gases. GWP should also allow nations to model the impact that various changes (mitigations) would have on overall warming. For gases that persist for over 100 years, like carbon dioxide (CO2) and nitrous oxide (N2O), GWP100 works well. However, because methane breaks down over just 12 years, GWP100 does not show the true impact of methane on global warming.
- **The United Nations recognizes that GWP100 is** inaccurate when measuring the warming impact of short-lived GHGs such as methane. In the UN IPCC's 6th Assessment Report (AR6), it acknowledges that other measures such as GWP* can more accurately model this. However, GWP100 remains the official standard for international reporting for the time being. Given the long timescales international decision-making often works on, this is unlikely to change in the immediate future.
- **That is why, some of the world's big, industrialized meat and dairy companies have been promoting a new metric for measuring methane emissions, called GWP* (pronounced as GWP star), which they argue is a more accurate way to calculate emissions from the greenhouse gas (GHG)**. However, by adopting this new method, they can manipulate their overall GHG emissions and escape accountability by falsely claiming climate neutrality, a new report has revealed.

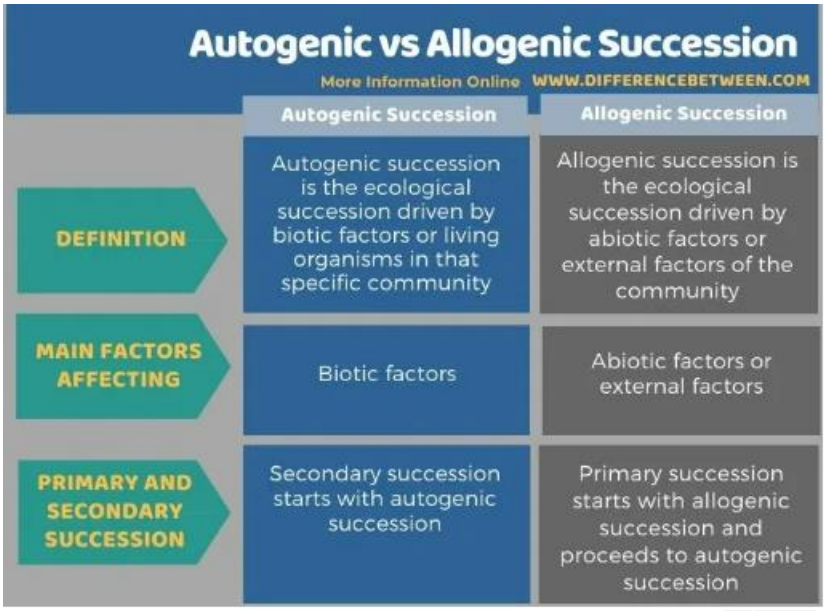
Q 60.B

The reasons for migration can be put into two broad categories -:

- **Push factors:** These cause people to leave their place of residence or origin; For e.g. - Poverty, High population pressure on the land (**Small size of land holdings**), Lack of basic infrastructural facilities like health care, education, Natural disasters such as, flood, **drought**, cyclonic storms, earthquake etc. **Hence, option (b) is the correct answer.**
- Pull factors: They attract the people from different places. For e.g. - **Better opportunities,** Availability of regular work and relatively higher wages, Better opportunities for education, **better health facilities and sources of entertainment** etc.

Q 61.D

- Ecological succession is the process by which the structure and composition of a community changes over time. This process can be driven by both internal (autogenic) and external (allogenic) factors.
  - **Autogenic:**
    - ✓ Autogenic factors are **internal processes that arise within the ecosystem itself,** such as **competition, Predation, Herbivory, or Disease**. These factors can lead to changes in species abundance and diversity, ultimately altering the structure and functioning of the ecosystem.
  - **Allogenic:**
    - ✓ Allogenic factors are **external disturbances that originate outside the ecosystem.** These disturbances can cause significant disruptions to the ecosystem, setting back successional progress or altering the trajectory of successional change. Examples of allogenic factors include **natural disasters, climate change, and the introduction of new species. Hence option (d) is the correct answer.**



- **Explanation of Options:**
  - **The increase in soil fertility due to the decomposition of organic matter is an example of an autogenic succession factor.** This process gradually enriches the soil with nutrients, leading to changes in plant growth and community composition.
  - **The competition between different plant species for sunlight is also an example of an autogenic succession factor.** As plants grow taller and denser, they compete for access to sunlight, influencing the distribution and abundance of different species.
  - **The exponential changes in species composition due to competitive interactions is another example of an autogenic succession factor.** Competitive interactions can lead to the decline or elimination of certain species, while others thrive, resulting in significant shifts in community structure.
  - **The introduction of a new species that prey on native species is an example of an allogenic succession factor.** The introduction of a new predator can disrupt the existing predator-prey dynamics, leading to changes in prey populations and species interactions. This external disturbance can trigger a shift in the trajectory of successional change.

Q 62.B

- According to the assessment of UN-backed experts, the successful phasing out of banned substances as envisioned by the Montreal Protocol has set the stage for a complete recovery of the ozone layer by the 2060s.
- The Montreal Protocol enforced in 1989 called for a **ban on the use and trade of 100 ozone-depleting substances (ODS),** and 99 percent of these have been successfully phased out, the Scientific Assessment Panel to the Montreal Protocol said, adding that if current policies remain in place, the ozone layer is expected to recover to 1980 values (before the appearance of the ozone hole) by around 2066 over the Antarctic, by 2045 over the Arctic and by 2040 for the rest of the world.
  - **ODS are human-made chemicals containing chlorine and bromine** like Chlorofluorocarbons (CFCs), HCFC, tetrachloride, etc. **Hence statement 2 is correct.**
  - ODS after reaching stratosphere undergo catalytic reactions that depletes stratospheric ozone.
- The success of the Montreal Protocol inspires confidence in the scientific community and governments who are trying to reduce greenhouse gas emissions that induce climate change, the Scientific Assessment Panel said during the meeting.
- **The implementation of the 2016 Kigali Amendment to the Montreal Protocol for phasing out some hydrofluorocarbons (HFC), for instance, can gain from the success of the ODS ban, the scientists noted. Reducing the concentration of HFCs can help avoid 0.3-0.5°C of global warming over pre-industrial levels by the end of this century.**
- A number of commonly used chemicals have been found to be extremely damaging to the ozone layer. Halocarbons are chemicals in which one or more carbon atoms are linked to one or more halogen atoms (fluorine, chlorine, bromine or iodine). Halocarbons containing bromine usually have much higher ozone-depleting potential (ODP) than those containing chlorine. Antarctic ozone depletion occurs when human-made chemicals containing chlorine and bromine first rise into the stratosphere.

- **Apart from these, recently, scientists have said that The Hunga Tonga-Hunga Ha'apai volcano — which violently erupted in January 2022 and blasted an enormous plume of water vapor into the stratosphere — likely contributed to this year's substantial ozone depletion. That water vapor likely enhanced ozone-depletion reactions over the Antarctic early in the season. Hence, statement 1 is correct.**
- **While this is an achievement, the scientists warned of the detrimental effects of geoengineering technologies such as stratospheric aerosol injection on the ozone layer. SAI can increase sunlight reflection, thereby lowering the amount of heat that enters the troposphere. But this method "could also affect stratospheric temperatures, circulation and ozone production and destruction rates and transport. Hence, statement 3 is not correct.**
- Injection of sulphuric acid into the stratosphere, for example, would damage the ozone layer, according to a 2016 study by researchers from the John A Paulson School of Engineering and Applied Sciences, Harvard University, Cambridge published in the journal PNAS. Aerosol sprays, like other commonly used substances such as dry cleaning solvents, refrigerants and fumigants, contain ODS.

Q 63.B

- **Guild in a Community:**
  - **In ecosystems, where diverse organisms interact and coexist, guilds emerge as distinct groups of species that share similar ecological roles.** These guilds, often composed of species from different taxonomic groups, are united by their shared exploitation of specific resources in comparable ways.
  - **Guilds represent a functional grouping of species within a community, characterized by their shared resource utilization and foraging strategies.**
  - Members of a guild exploit the same resources, such as food, habitat, or shelter, in a similar manner.
  - This shared niche partitioning allows for coexistence among guild members, as they specialize in different aspects of resource acquisition. For instance, in a forest ecosystem, a guild of insectivores might include birds, bats, and shrews, all of which prey on insects but differ in their foraging techniques and preferred prey species.
  - Examples of Guilds include, **Birds that hunt for insects on the floor of a deciduous forest constitute a guild**; **tropical American hummingbirds and butterflies jointly form a guild of daytime nectar feeders; desert sparrows, ants, and rodents constitute a seed-eating guild.**
- **Bees, Butterflies, and American Humming Bird:**
  - Bees, butterflies, and American hummingbirds are all found in meadows and feed on nectar from flowers. They are all pollinators, which means they play an important role in the reproduction of plants.
  - **While they share the same resource (nectar) and have a similar role in the ecosystem (pollination), they differ in their foraging strategies and prey preferences.**
  - Bees are adapted to feeding on flowers with deep corollas, while butterflies are adapted to feeding on flowers with shallow corollas. Hummingbirds, on the other hand, have long beaks that allow them to reach the nectar of flowers that are inaccessible to other pollinators. **Therefore, they form a guild. Hence option (b) is correct.**
- **Other options:**
  - **Lions, zebras, and gazelles:**
    - ✓ Lions, zebras, and gazelles are all part of the same food chain in an African savanna ecosystem. Lions are apex predators that hunt zebras and gazelles, while zebras and gazelles are herbivores that graze on grasses and other plants.
    - ✓ While they all share the same habitat, they do not exploit the same resource in a similar manner. Lions are predators, while zebras and gazelles are prey**. Therefore, they do not form a guild. Hence option (a) is not correct.**
  - **Desert Sparrow, Butterfly, and Ants:**
    - ✓ Desert sparrows, butterflies, and ants are all found in desert habitats and feed on a variety of food sources. Desert sparrows are omnivores and eat a variety of seeds, insects, and other small animals.
    - ✓ Butterflies are herbivores and feed on the nectar and pollen of flowers. Ants are omnivores and eat a variety of insects, seeds, and other small animals. While they share the same habitat, they do not exploit the same resource in a similar manner.
    - ✓ Desert sparrows are primarily seed-eaters, while butterflies are primarily nectar and pollen feeders, and ants are generalist feeders. **Therefore, they do not form a guild. Hence option (c) is not correct.**

- **Polar Bears, Penguins, and Seals:**
    - ✓ Polar bears, penguins, and seals are all found in polar regions and feed on marine animals. Polar bears are apex predators that hunt seals and other marine mammals.
    - ✓ Penguins are flightless birds that feed on fish, krill, and other marine invertebrates. Seals are marine mammals that feed on fish, squid, and other marine invertebrates.
    - ✓ While they share the same habitat, they do not exploit the same resource in a similar manner. Polar bears are apex predators, while penguins and seals are prey. **Therefore, they do not form a guild. Hence option (d) is not correct.**

Q 64.D

- **The pyramid of biomass**
    - The pyramid of biomass is a useful tool for understanding the flow of energy through an ecosystem and the relative importance of different trophic levels. It also helps to illustrate the **concept of ecological efficiency, which refers to the percentage of energy that is transferred from one trophic level to the next.**
    - In a typical pyramid of biomass, **the amount of biomass decreases as we move from the lower trophic levels to the higher trophic levels. This is because energy is lost at each trophic level through respiration and other metabolic processes.** Only a small fraction of the energy consumed by an organism is converted into new biomass, while the rest is lost as heat.
    - While the pyramid of biomass is typically upright in terrestrial ecosystems, **it can be inverted in aquatic ecosystems, particularly in open oceans.** This means that the total biomass of primary producers (phytoplankton) is significantly greater than the total biomass of primary consumers (zooplankton).
- **Reasons for Inverted Pyramid of Biomass:**
  This seemingly contradictory situation can be explained by several factors that contribute to t**he efficient transfer of energy through the aquatic food web:**
    - **High Productivity of Phytoplankton:** Phytoplankton are incredibly efficient at converting sunlight into energy through photosynthesis. **They have a high turnover rate,** meaning they reproduce quickly and can replenish their biomass rapidly. This high productivity provides a substantial food source for the zooplankton that graze on them. **Hence statement 1 is not correct.**
    - **Lower metabolic rate,** Zooplankton are generally small organisms, ranging in size from microscopic rotifers to larger copepods. Their small body size means they have a **lower metabolic rate,** consuming less energy relative to their body size compared to larger organisms. This efficient energy use allows more energy to be transferred to higher trophic levels.
    - **Efficient Grazing Strategies:** Zooplankton have evolved various grazing strategies to maximize their energy intake from phytoplankton. Some zooplankton filter-feed, passively collecting phytoplankton as they swim through the water, while others actively chase and capture their prey. These efficient grazing techniques ensure that a significant portion of the energy produced by phytoplankton is transferred to zooplankton. **Hence statement 2 is not correct.**
    - **Short Food Chains:** Aquatic food chains are often shorter than terrestrial food chains, with fewer trophic levels between primary producers and top consumers. This means that less energy is lost through respiration at each trophic level, resulting in a more efficient transfer of energy to higher levels. **Hence statement 3 is not correct.**
    - **Recycling of Nutrients:** Nutrients in aquatic ecosystems are efficiently recycled through various processes, such as decomposition and the action of detritivores. This recycling ensures that nutrients are readily available for phytoplankton growth, sustaining their high productivity and maintaining the inverted pyramid of biomass.

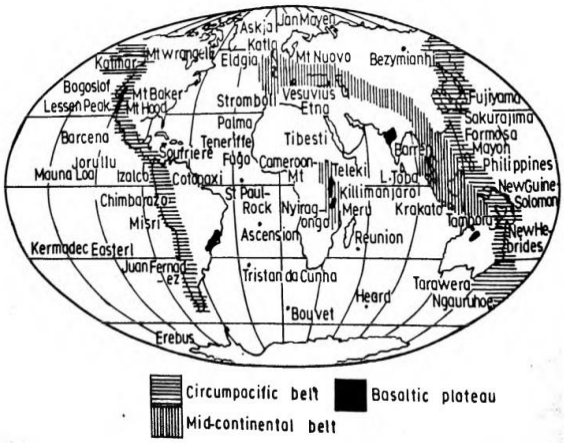
Q 65.A

- **Pair 1 is correctly matched:** Oil was discovered in many parts of Sahara and Arabian Deserts.
- **Pair 2 is not correctly matched:** Discovery of **diamonds and copper** was done in the Kalahari Desert.
- **Pair 3 is not correctly matched:** Caliche (cemented gravels) which is mined from the Atacama Desert for **Sodium Nitrate**, a valuable fertilizer, is extracted and exported to all parts of the world. Atacama desert is also a rich source of copper.

Q 66.B

- A **volcano i**s a geological feature on the Earth's surface that is formed by the **eruption of magma from beneath the Earth's crust.** Several factors contribute to the occurrence of volcanic eruptions these are: **Subduction Zones. Mantle Plumes, Divergent Boundaries, Convergent Boundaries, Pressure buildup within magma.**

- **The Circum - pacific belt,** also known as the **'volcanic zones of the convergent oceanic plate margins**', includes the volcanoes of the **eastern and western coastal areas of the Pacific Ocean**. This volcanic belt is also called the **Fire Girdle of the Pacific** or the **Fire Ring of the Pacific.** Here volcanic eruptions are primarily caused due to **collision of American and Pacific plates and due to subduction** of Pacific Plate below Asiatic plate. **Hence pair 1 is not correctly matched.**
- **Mid-Continental Belt**— This belt is also known as **'the volcanic zones of convergent continental plate margins '**. This belt includes the volcanoes of Alpine mountain chains and the Mediterranean Sea and the volcanoes of fault zones of eastern Africa. Here, the volcanic eruptions are **caused due to convergence and collision of Eurasian plates and African and Indian plates**. **Hence pair 2 is correctly matched.**
- **Mid-Atlantic Belt**— This belt includes the volcanoes mainly along the mid-Atlantic ridge which represents the **splitting zone of plates**. In other words, two plates **diverge in opposite directions** from the mid-oceanic ridge. Thus, volcanoes mainly of fissure eruption type occur along the constructive or divergent plate margins. **Hence pair 3 is correctly matched.**



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

Q 67.A

- **Bhavani Island**: This 130-acre island has been **created by the force of River Krishna** and is situated 4km away from Vijayawada in Andhra Pradesh. **Hence pair 1 is incorrectly matched.**
  - It is located at the upstream of Prakasam Barrage and is considered one of the largest river islands in India.
- **Umananda Island: Umananda Island, also called Peacock Island, is the smallest inhabited island in the world and rests on the Brahmaputra** River in Guwahati, Assam. **Hence pair 2 is correctly matched.**
  - It is inhabited by endangered golden langurs. These animals are considered to be sacred, and their numbers are slowly, but steadily, gone up in recent years.
- **Nongkhnum River Island** in Meghalaya is the biggest river island in the state and is believed to be Asia's second biggest. It is located in the West Khasi Hills district. **Hence pair 3 is incorrectly matched.**
  - **The island is formed by the rivers Wah Kynshi and Namiliang.**
- **Other River Islands**
  - Majuli - Brahmaputra
  - Divar Island - Mandovi River
  - Srirangam - Cauvery
  - Munroe Island in Kerala. Located at the confluence of Kallada River and Ashtamudi lake
  - Parumala is in Kerala. Located in Pampa River

Q 68.B

- Indian Railways (IR), with more than 160 years of rich history; presents a wide spectrum of both tangible and intangible heritage.
- IR occupies a special place within the national heritage spectrum of India. Over the years, IR has been endeavouring a sustained and focused approach to safeguarding its industrial as well as living heritage and transmitting it intact to future generations.
- **Indian Railways is the proud owner of four UNESCO accorded World Heritage Sites namely Darjeeling Himalayan Railway (1999), Nilgiri Mountain Railway (2005), Kalka Shimla Railway**

(2008) and Chhatrapati Shivaji Terminus, Mumbai (2004). There are two more in waiting or in the tentative list namely Matheran Light Railway and Kangra Valley Railway.

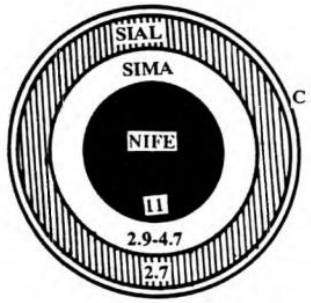
- Today, Indian Railways maintain 34 Museums, Heritage Parks and Heritage galleries, spread all over India, to create unique and rich experiences for visitors about Railway heritage in India. The National Rail Museum in New Delhi and Regional Rail Museums at Chennai, Mysore, Howrah and Nagpur, are iconic tourist destinations in their region.
- **Hence, option (b) is the correct answer.**

Q 69.C

- **Biological oxygen demand (BOD)**
  - Biological oxygen demand (BOD) is a measure of the amount of dissolved oxygen (DO) required by aerobic organisms to break down organic matter in water over a specific period of time. **Hence statement I is correct.**
  - BOD is a widely used indicator of water quality, as it reflects the amount of organic pollution in the water.
  - Higher BOD values indicate the presence of more organic matter, which requires more oxygen to decompose. A low BOD value typically indicates a clean or minimally polluted water body. This is because a low BOD value means that there is not much organic matter present to consume dissolved oxygen. **Hence statement II is not correct.**

Q 70.A

- **The Earth is composed of various elements** and compounds that make up its structure. The most abundant elements in the Earth's crust are oxygen, silicon, aluminum, iron, calcium, sodium, and potassium. These elements combine to form minerals, which are the building blocks of rocks.
- **The Earth's crust** is composed of various minerals, rocks, and elements. The **crust is covered by a thin layer of sedimentary rocks of very low density.** This layer is composed of crystalline rocks, **mostly silicate matter**. The **dominant minerals are feldspar and mica. Hence statement 1 is correct.**
- The **upper part of the crust is composed of light silicate matter** while **heavy silicate matter dominates in the lower part.** the other elements in the Earth's crust are oxygen, aluminum, iron, calcium, sodium, and potassium. **Hence statement 2 is not correct.**



- **The Earth's core** is **primarily composed of iron and nickel and not of silica and magnesium**, with smaller amounts of other elements. It is divided into two main layers: the **outer core and the inner core**.The composition of the Earth's core is inferred through **seismic studies,** experimental data on materials under extreme pressure and temperature conditions, and models of planetary formation. **Hence statement 3 is not correct.**

Q 71.C

- **Quinary Activities**
  - The highest level of decision makers or policy makers perform quinary activities. These are subtly different from the knowledge-based industries that the quinary sector in general deals with.
  - **Quinary activities are services that focus on the creation, re-arrangement and interpretation of new and existing ideas; data interpretation and the use and evaluation of new technologies. Hence, statement 1 is correct.**
  - Often referred to as 'gold collar' professions, they represent another subdivision of the tertiary sector representing special and highly paid skills of senior business executives, government officials, research scientists, financial and legal consultants, etc. Their importance in the structure of advanced economies far outweighs their numbers.

- **The services provided under the quinary sector can't be completely outsourced. Hence, statement 2 is correct.**

- **Quaternary activities**
  - **They involve some of the following: the collection, production and dissemination of information or even the production of information.**
  - Quaternary activities centre around research, and development and may be seen as an advanced form of services involving specialised knowledge and technical skills.
  - The Quaternary Sector along with the Tertiary Sector has replaced most of the primary and secondary employment as the basis for economic growth. Over half of all workers In developed economies are in the 'Knowledge Sector' and there has been a very high growth in demand for and consumption of information-based services from mutual fund managers to tax consultants, software developers and statisticians.
  - Personnel working in office buildings, elementary schools and university classrooms, hospitals and doctors' offices, theatres, accounting and brokerage firms all belong to this category of services.
  - **Like some of the tertiary functions, quaternary activities can also be outsourced.** They are not tied to resources, affected by the environment, or necessarily localised by the market.

Q 72.A

- **Recent Context: Researchers have discovered an extremely high-energy particle that came from a part of the universe where there is nothing. It was named "Amaterasu" after a Japanese goddess. The Amaterasu particle has an energy exceeding 240 exa-electron volts (EeV).** That is millions of times more powerful than the particles produced by the Large Hadron Collider, which is the most powerful accelerator ever built. It is second only to the "Oh-My-God" particle, another high-energy cosmic ray detected in 1991. That came in at 320 EeV. **Hence, statement 1 is correct.**
- It is common for Earth to receive low-energy cosmic ray, but those with extremely high energy come rarely. They are thought to travel to Earth from other galaxies and sources beyond our Milky Way. When the researchers tried to find the source of the energy spike, they found nothing, according to Nature. Ultra-high energy particles like Amaterasu usually travel through space quite smoothly since they don't bounce off magnetic fields, like low-energy cosmic rays. Technically, this should make it easier to pinpoint the location where it came from, but that was not the case. **Hence, statement 2 is not correct.**

Q 73.A

Anabolism and catabolism are two fundamental processes in the realm of ecology, each with its distinct role in the flow of energy and matter within ecosystems. They are two subcategories of metabolism. **Anabolism refers to the process of growth, whereas catabolism refers to the process of breakdown.**

- **Anabolism:**
  - Anabolism refers to the biosynthetic phase of metabolism, **where complex organic compounds are built from simpler forms.**
  - It represents the **constructive aspect of metabolism**, involving energy-requiring reactions. Anabolism plays a pivotal role in the capture and utilization of energy from the environment.
  - A prime **example of anabolism is photosynthesis i**n green plants, where carbon dioxide and water are transformed into complex carbohydrates like glucose using the energy harnessed from sunlight. Essentially, anabolism is responsible for the production of the organic matter that forms the foundation of ecological food chains.
  - This process requires energy in the form of ATP to produce cell components such as proteins, carbohydrates, and lipids.
- **Catabolism:**
  - Catabolism involves the degradative phase of metabolism. **In this process, complex organic compounds are broken down into simpler forms, often releasing energy in the process.**
  - Catabolic reactions are essential for harnessing the stored energy in organic matter, making it accessible to organisms for their metabolic needs.
  - **Catabolism includes activities such as respiration**, where complex organic compounds are broken down into simpler forms (e.g., glucose into carbon dioxide and water), releasing energy for the organism's use.
  - It is a metabolic condition that is **destructive in nature.**
- **Hence option (a) is the correct answer.**

Q 74.A

- **Recent Context: The Central Bureau of Investigation (CBI), as part of its 'Chakra-II' operation, has achieved a major** breakthrough in two more cases **involving an international online investment fraud worth hundreds of crores targeting Indians; and a cyber-enabled impersonation racket in which Singaporean citizens were cheated.**
- The first case was registered by the agency last year, based on inputs from various sources, including the Indian Cyber Crime Coordination Centre (I4C) under the Ministry of Home Affairs. As alleged, in conspiracy with local associates, the accused based overseas cheated Indian citizens on the pretext of investment, loans, and job opportunities.
- **The Central Bureau of Investigation (CBI) has launched Operation Chakra-II to fight against transnational organized cyber-enabled financial crimes in India. For this, India's federal agency has partnered with Microsoft and Amazon as well as with national and international agencies to combat and dismantle infrastructure of illegal call centers. hence, option (a) is the correct answer.**
- The CBI is working closely with various international agencies to gather information and leads. Some of the agencies involved include the Federal Bureau of Investigation (FBI) in the United States, INTERPOL's Cyber Crime Directorate and IFCACC, the National Crime Agency (NCA) in the United Kingdom, the Singapore Police Force, and Germany's BKA (Bundeskriminalamt).

Q 75.D

- **Limiting factors:**
  - **Limiting factors are environmental conditions that restrict the growth, abundance, or distribution of populations.** They can be classified into two main categories: density-dependent and density-independent.
    - ✓ **Density-dependent:**
      - Density-dependent limiting factors are those that have a **greater impact on populations as their density increases.**
      - **Examples of density-dependent limiting factors include competition, predation, and disease.**
    - ✓ **Density-independent:**
      - Density-independent limiting factors are those **that affect populations regardless of their density**.
      - **Examples of density-independent limiting factors include natural disasters, climate change, and habitat destruction.**
- **Explanation of options:**
  - **Competition**
    - ✓ Competition is a **density-dependent limiting factor** because it becomes more intense as the density of a population increases. As more individuals compete for the same resources, their growth and survival rates decline.
  - **Predation**
    - ✓ Predation is a **density-dependent limiting factor** because it becomes more effective as the density of prey increases. With more prey available, predators can catch and consume more individuals, reducing the prey population.
  - **Mutualism**
    - ✓ Mutualism is a symbiotic relationship between two species in which both species benefit. **It is not a limiting factor,** but rather a beneficial interaction that can enhance the survival and reproduction of both species.
- **Hence option (d) is the correct answer.**

Q 76.A

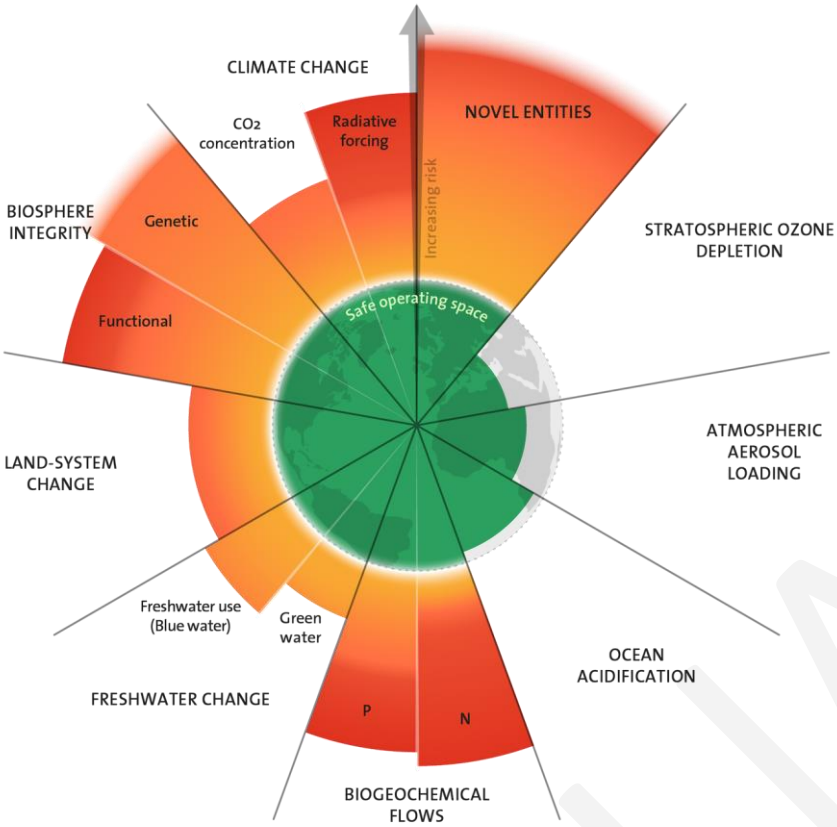
- Ecosystems are complex systems that provide a variety of benefits to humans and the environment. These benefits, known as ecosystem services, can be broadly categorized into four main types:
  - **Provisioning services:**
    - ✓ These are the tangible goods that ecosystems provide to humans, such as ***Provision of food,*** **water, timber, and fiber.**
  - **Regulating services:**
    - ✓ These are the processes that ecosystems perform to regulate the natural environment and provide benefits to humans, such as climate regulation, **water purification, pollination, pest and disease control, *Carbon Sequestration* and storage, and Moderation of Extreme events.**

- **Supporting services:**
  - ✓ Supporting services are the fundamental ecosystem processes that underpin the functioning of ecosystems. **They provide the basis for all other ecosystem services, including provisioning, regulating, and cultural services.**
  - ✓ Supporting services are often **not directly visible or tangible**, but they are essential for the health and well-being of ecosystems and the people who depend on them.
  - ✓ These are the essential processes that underpin the functioning of ecosystems, such as **nutrient cycling, soil formation, primary production, and *Maintenance of Genetic Diversity.***
- **Cultural services:**
  - ✓ These are the **non-material benefits** that ecosystems provide to humans, such as ***recreation and tourism*, aesthetic enjoyment, spiritual fulfillment, and inspiration for art, literature, and music.**

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

Q 77.B

- **The world has breached six of the nine planetary boundaries necessary to maintain Earth's stability and resilience, according to a new study. Hence, statement 4 is not correct.**
- The planetary boundaries framework was first proposed by Johan Rockström and a group of 28 internationally renowned scientists in 2009 to define the environmental limits within which humanity can safely operate to maintain Earth's stability and biodiversity.
- **The study, published in Science Advances, was carried out by 29 scientists from eight different countries. The findings are an update to the planetary boundaries framework that was launched in 2009 to define the environmental limits within which humanity can safely operate. Hence, statement 1 is correct but statement 2 is not correct.**
- **The six boundaries include climate change, biosphere integrity (which includes genetic diversity and energy available to ecosystems), land system change, freshwater change (which includes changes across the entire water cycle over land), biogeochemical flows (nutrient cycles), and novel entities (consisting of microplastics, endocrine disruptors, and organic pollutants).**
- The researchers first identified the processes in the Earth's ecosystem that have been important for maintaining favorable conditions for humans in the last 12,000 years. Then they assessed and identified the level at which human activities raise the risk of potentially dramatic and irreversible changes in the overall conditions on Earth using computer simulations.The study results show that humans have caused a breach in our planet's safe climate and land system in 1988 and are now facing a risk of systemic disruption.
- For land system change, the global area of forested land as the percentage of the original forest cover boundary has dropped from 75 percent to 60 percent, which is beyond safe limits. As for biosphere integrity, the researchers kept a limit of less than 10 extinctions per million species-years. However, the study estimated the extinction rate was greater than 100 extinctions per million species-years. Currently, it is estimated around one million of the 8 million plant and animal species are threatened with extinction, and over 10 percent of the genetic diversity of plants and animals may have been wiped out over the last 150 years.
- The analysis also showed that violations of blue and green water boundaries occurred in 1905 and 1929, respectively. The planetary boundary of novel entities was calculated to be zero. This means humans have transgressed this limit as well. Stratospheric ozone depletion, aerosol loading and ocean acidification were found to be within the planetary boundary.
- **One of the planetary boundaries identified is novel entities which include substances like microplastics, endocrine disruptors and organic pollutants. The planetary boundary for novel entities was initially set at zero, emphasizing their absence in Earth's natural systems. This boundary has been transgressed. Risks associated with this transgression include stratospheric ozone depletion, aerosol loading, and ocean acidification, each carrying its own set of consequences. Hence, statement 3 is correct.**



Q 78.D

- **PM Vishwakarma, a Central Sector Scheme was launched recently by the Prime Minister to provide end-to-end support to artisans and craftspeople who work with their hands and tools. Ministry of Micro, Small & Medium Enterprise is the nodal ministry of PM Vishwakarma Yojana.**
- The Scheme covers artisans and craftspeople engaged in 18 trades, viz. Carpenter (Suthar/Badhai), Boat Maker, Armourer, Blacksmith (Lohar), Hammer and Tool Kit Maker, Locksmith, Goldsmith (Sonar), Potter (Kumhaar), Sculptor (Moortikar, stone carver), Stone breaker, Cobbler (Charmkar)/ Shoesmith/Footwear artisan, Mason (Rajmistri), Basket/Mat/Broom Maker/Coir Weaver, Doll & Toy Maker (Traditional), Barber (Naai), Garland maker (Malakaar), Washerman (Dhobi), Tailor (Darzi) and Fishing Net Maker.
- The Scheme envisages provisioning of the following benefits to the artisans and crafts persons:
  - **Recognition: Recognition of artisans and craftspeople through PM Vishwakarma certificate and ID card.**
  - **Skill Upgradation**: Basic Training of 5-7 days and Advanced Training of 15 days or more, with a stipend of Rs. 500 per day.
  - **Toolkit Incentive**: A toolkit incentive of upto Rs. 15,000 in the form of e-vouchers at the beginning of Basic Skill Training.
  - **Credit Support**: Collateral free 'Enterprise Development Loans' of upto Rs. 3 lakh in two tranches of Rs. 1 lakh and Rs. 2 lakh with tenures of 18 months and 30 months, respectively, at a concessional rate of interest fixed at 5%, with Government of India subvention to the extent of 8%. Beneficiaries who have completed Basic Training will be eligible to avail the first tranche of credit support of upto Rs. 1 lakh. The second loan tranche will be available to beneficiaries who have availed the 1st tranche and maintained a standard loan account and have adopted digital transactions in their business or have undergone Advanced Training.
  - **Incentive for Digital Transaction**: An amount of Re. 1 per digital transaction, upto maximum 100 transactions monthly will be credited to the beneficiary's account for each digital pay-out or receipt.
  - **Marketing Support**: Marketing support will be provided to the artisans and craftspeople in the form of quality certification, branding, onboarding on e-commerce platforms such as GeM, advertising, publicity and other marketing activities to improve linkage to value chain.
- **Eligibility criteria for the scheme**:
  - An artisan or craftsperson working with hands tools and engaged in one of the family-based traditional trades in unorganized sector

- **Minimum age of the beneficiary should be 18 years.**
- **The registration and benefits under the scheme shall be restricted to one member of the family. For availing benefits under the scheme, a family is defined as consisting the husband, wife and un unmarried children.**

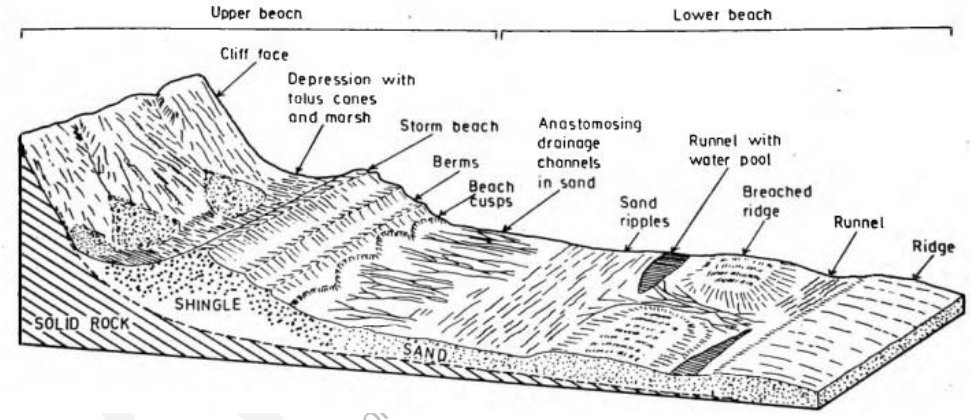
- **Hence, option (d) is the correct answer.**

Q 79.A

- **India currently ranks third among the largest generators** of e-waste globally, behind only China and the US. The volume of e-waste in India has witnessed a significant surge—from 700,000 tonnes in 2017-18 to 1.6 million tonnes in 2021-22. **Hence statement 1 is correct.**
- **India recycled only 32.9 per cent of the e-waste generated in 2021-2022** according to data from the Central Pollution Control Board (CPCB). While the figure has gone up from previous years, it indicates that a staggering 10,74,024 tonnes (67%) of e-waste remained unprocessed. **Hence statement 2 is not correct.**
- Unprocessed e-waste poses a risk to health and the environment as it contains several toxic substances such as lead, cadmium, mercury, polychlorinated biphenyls (PCBs), etched chemicals, arsenic and asbestos, which can be hazardous if not disposed of in a scientific manner.

Q 80.D

- The work of sea water is performed by several marine agents like **sea waves, oceanic currents, tidal waves and tsunamis** but the **sea waves are the most powerful and effective erosive agent of coastal areas**. The nature and magnitude of coastal erosion are affected and determined by factors like **Wavelength, wave velocity, wave frequency, and wave period.** Sea waves play a crucial role in shaping coastal landforms through a process known as coastal erosion and deposition.
- significant coastal features formed due to marine erosion by sea waves and other currents and solutional processes include **cliffs, coves, caves, indented coastline, stacks, chimneys, arches, inlets, wave-cut platforms etc.**
- **Depositional landforms** developed by sea waves include **sea beaches, bars and barriers, offshore and longshore bars, spits, hooks, loops, connecting bars, looped bars, tombolo, barrier islands, tidal inlets, winged headlands, progradation, wave-built platforms.**



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

Q 81.D

- **Water vapor is the gaseous form of water,** When water evaporates, it turns into water vapor. Water vapor is formed when liquid water changes into its gaseous state through a process called **evaporation.** This occurs when water is heated, such as by the sun's energy, or when air with lower water vapor pressure comes into contact with a water surface.
- **The distribution** of water vapor in the Earth's atmosphere exhibits variations based on both **latitude and altitude**.
  - **Latitude (Equator to Poleward):** Near the **equator,** where the **climate is generally warmer, there is more energy available to evaporate water from the surface**. As one moves **poleward, the climate tends to be cooler,** and there is generally less available energy for evaporation. Therefore, the **water vapor content decreases away from the equator.**
  - **Altitude (Decreases Upward**): In the vertical direction, the **concentration of water vapor decreases with increasing altitude**. This is because the **temperature tends to decrease with altitude** in the troposphere (the lowest layer of the Earth's atmosphere).

- As air rises, it cools, and if it reaches its saturation point, water vapor can condense to form clouds and precipitation. This is why the upper troposphere and stratosphere have lower water vapor content compared to the lower troposphere. **Hence statement 1 is not correct.**
- The amount of **water vapor that air can hold is strongly influenced by temperature**. As the temperature increases, air molecules move faster, and the air can hold more water vapor. Conversely, as the temperature decreases, the air's capacity to hold water vapor diminishes. Hence **statement 2 is correct**.

Q 82.C

- **Recently, a study published in the Lancet has established a relationship between PM2.5 and anti-microbial resistance. PM 2.5 carries abundant antibiotic resistance-determinant genes. T**hese levels are higher than what is found in sediments, soil, rivers and some engineering treatment systems. Humans could be directly exposed to antibiotic-resistant elements while inhaling air pollutants. **Hence, statement 2 is correct.**
- Airborne particulate matter (PM) is not a single pollutant but rather is a mixture of many chemical species. It is a complex mixture of solids and aerosols composed of small droplets of liquid, dry solid fragments, and solid cores with liquid coatings. Particles vary widely in size, shape and chemical composition, and may contain inorganic ions, metallic compounds, elemental carbon, organic compounds, and compounds from the earth's crust. Particles are defined by their diameter for air quality regulatory purposes. Those with a diameter of 10 microns or less (PM10) are inhalable into the lungs and can induce adverse health effects. Fine particulate matter is defined as particles that are 2.5 microns or less in diameter (PM2.5).
- PM may be either directly emitted from sources (primary particles) or formed in the atmosphere through chemical reactions of gases (secondary particles) such as sulfur dioxide (SO2), nitrogen oxides (NOX), and certain organic compounds. These organic compounds can be emitted by both natural sources, such as trees and vegetation, as well as from man-made (anthropogenic) sources, such as industrial processes and motor vehicle exhaust.
- A number of adverse health impacts have been associated with exposure to both PM2.5 and PM10. For PM2.5, short-term exposures (up to 24-hours duration) have been associated with premature mortality, increased hospital admissions for heart or lung causes, acute and chronic bronchitis, asthma attacks, emergency room visits, respiratory symptoms, and restricted activity days. These adverse health effects have been reported primarily in infants, children, and older adults with preexisting heart or lung diseases. **Maternal exposure to fine particulate air pollution (PM2.5) during pregnancy is associated with lower newborn birthweight, which is a risk factor for chronic disease. Hence, statement 4 is not correct.**
- **PM, primarily PM2.5, affects visibility by altering the way light is absorbed and scattered in the atmosphere. With reference to climate change, some constituents of the ambient PM mixture promote climate warming (e.g., black carbon), while others have a cooling influence (e.g., nitrate and sulfate), and so ambient PM has both climate warming and cooling properties. Hence, statement 1 is correct.**
- **PM can adversely affect ecosystems, including plants, soil and water through deposition of PM and its subsequent uptake by plants or its deposition into water where it can affect water quality and clarity. The metal and organic compounds in PM have the greatest potential to alter plant growth and yield. PM deposition on surfaces leads to soiling of materials. Hence, statement 3 is correct.**

Q 83.B

- **Context: In a move meant to put the Indian system of medicine on the world map and provide it with a common standardized language, the Union government has sought for Ayurveda and related systems to be included in the 11th revision of the World Health Organisation's International Classification of Diseases (ICD), as the second module of a supplementary chapter on traditional medicine conditions.**
- The ICD provides a common language that allows health professionals to share standardized information across the world. The traditional medicine module of the 11th revision provides a list of diagnostics categories to collect and report on traditional medicine conditions in a standardized and internationally comparable manner.
- **ICD serves a broad range of uses globally and provides critical knowledge on the extent, causes and consequences of human disease and death worldwide via data that is reported and coded with the ICD.** Clinical terms coded with ICD are the main basis for health recording and statistics on disease in

primary, secondary and tertiary care, as well as on cause of death certificates. **Hence, statement 2 is correct.**

- For more than a century, **the International Classification of Diseases (ICD) has been the basis for comparable statistics on causes of mortality and morbidity between places and over time. The idea originated in the 19th century. Hence, statement 1 is not correct.**
- **It is prepared and maintained by the World Health Organization. The latest version of the ICD, ICD-11, was adopted by the 72nd World Health Assembly in 2019 and came into effect on 1st January 2022. Hence, statement 3 is correct.**

Q 84.B

- **Human activities contribute 25 per cent of global dust emission**s, with agriculture being the main anthropogenic source, according to the United Nations Convention to Combat Desertification (UNCCD). UNCCD, which is one of three Conventions that originated at the 1992 Earth Summit in Rio de Janeiro, released policy recommendations during a five-day meeting from November 13-17 in Uzbekistan.
- Sand and dust storms are a meteorological phenomenon characterised by strong and turbulent winds lifting an ensemble of small particles to great heights. They are known to have adverse impacts on human health, the environment and economies.
- **Sand and dust storms present a formidable challenge to achieving 11 of the 17 Sustainable Development Goals, according to the United Nations Food and Agriculture Organization (FAO) report** Sand and dust storms: A Guide to Mitigation, Adaptation, Policy, and Risk Management Measures in Agriculture. "It is a costly phenomenon that wreaks havoc everywhere from Northern and Central Asia to sub-Saharan Africa," Ibrahim Thiaw, UNCCD's Executive Secretary, said in a statement.
- **The main sources of sand and dust storms are the world's drylands. About 75 per cent of emissions come from natural sources such as hyper-arid regions, topographic depressions in arid areas and dry ancient lake beds with little vegetative cover. Abandoned cropland, for instance, are a source of sand and dust storms.** Further, water consumption in agriculture shrinks water bodies, creating new sources of sand and dust storms. **Hence, statement 1 is not correct.**
- **For example, the excessive diversion of water from rivers in Central Asia over several decades towards agriculture has shrunk the Aral Sea, a pre-existing lake between Kazakhstan to its north and Uzbekistan to its south. It has now become the Aralkum Desert, a significant new source of sand and dust storms. Hence, statement 2 is correct**.
- Climate change, too, plays a role. Extreme wind events, aridity and frequent, severe and longer droughts worsen the storms. Other factors such as high air temperature, minimal precipitation and strong winds also act as drivers, the FAO stated. Sand and dust storms lower the yields and productivity of crops, trees, pastures, and livestock. However, many of these impacts have not yet been well-quantified, according to the FAO report.

Q 85.D

- **Context: The state government of Gujarat has banned the plantation of Conocarpus erectus trees, an exotic mangrove species, in both forest and non-forest areas due to their adverse impacts on the environment and human health.** The decision comes in response to research reports highlighting the negative effects of Conocarpus trees, including the spread of pollen that can cause diseases such as colds, coughs, asthma, and allergies. Conocarpus is an evergreen species with dark-green shiny leaves.
- It grows rapidly and is not preferred by wildlife or domesticated animals. Conocarpus trees offer several benefits, but as with any plant species, there are also potential drawbacks that need to be considered. **Proper planning and management are essential to maximize the advantages of these trees while minimizing their negative impacts. It has been used by various public authorities in India as landscaping for road medians, along roads, and in public gardens.**
- This tree is famous for its dark green leaves color throughout the year and withstands harsh environmental conditions such as high and low temperatures. **It is very adaptive and could grow even in areas with extreme salinity. It absorbs more water from soil than other species and is a threat to groundwater.**
- **Hence, option (d) is the correct answer.**

Q 86.C

- **Recent Context: The first INTERPOL operation named 'Operation Storm Makers II' specifically targeting the phenomenon of human trafficking-fuelled fraud has revealed further evidence that the crime trend is expanding beyond Southeast Asia.**

- Many of the hotspots are regularly used to traffic victims to notorious cyber scam centers in Southeast Asia. Victims are often lured through fake job ads and forced to commit online fraud on an industrial scale while enduring abject physical abuse. Fraud schemes include fake cryptocurrency investments, as well as work-from-home, lottery and online gambling scams.
- According to Interpol, the Telangana police registered one of the first cases in India of human trafficking committed for the purpose of forcing victims to commit cyber fraud.
- **Indian enforcement agencies also participated in the exercise. Law enforcement agencies in 27 countries across Asia and other regions were mobilized for the operation**.
- **About INTERPOL:** International Criminal Police Organization (INTERPOL) is an **inter-governmental organisation (not a UN agency) comprising 196 member countries (including India**), which helps police forces in all these countries to better coordinate their actions
- **Hence, option (c) is the correct answer.**

Q 87.B

- **Equatorial evergreen forests**
  - Equatorial evergreen forests are lush, vibrant ecosystems that thrive in the warm, humid conditions near the equator. These forests are renowned for their exceptional biodiversity, harboring a vast array of plant and animal species. Their unique characteristics and ecological significance make them crucial components of the Earth's biosphere.
- **Climate and Rainfall**
  - Equatorial evergreen forests are characterized by a consistently warm and humid climate. Temperatures typically range from 25°C to 35°C throughout the year, with minimal seasonal variations. Rainfall is abundant, with an average annual precipitation exceeding 2,000 millimeters. This combination of warm temperatures and consistent rainfall creates an ideal environment for a diverse range of organisms.
- **The following are characteristics of equatorial tropical rainforests:**
  - **They have buttress roots to support the heavy and tall trees.**
    - ✓ Equatorial evergreen forests are home to some of the tallest and heaviest trees in the world, reaching heights of over 50 meters and weighing thousands of tons.
    - ✓ Buttress roots, which are large, flange-like roots that extend outwards from the base of the trunk, provide additional support and stability, preventing the trees from toppling over in strong winds or during heavy rains. **Hence statement 1 is correct.**
  - **Vertically stratified Vegetation**
    - ✓ Arranged in layers known as canopies like the top, middle, and lower layers. Equatorial evergreen forests exhibit a well-defined vertical stratification, with distinct layers of vegetation occupying different heights.
    - ✓ This stratification allows for efficient use of sunlight and space, maximizing the diversity of plant life within the forest.
    - ✓ The emergent layer, canopy layer, understory layer, and forest floor each support a unique community of plants and animals, contributing to the overall biodiversity of the ecosystem. **Hence statement 2 is correct.**
  - **Nutrient-poor Soil**
    - ✓ The soils in equatorial evergreen forests are typically **nutrient-poor due to heavy rainfall leaching nutrients away**. T
    - ✓ he rapid decomposition of organic matter also contributes to the low nutrient content of the soil.
    - ✓ This nutrient deficiency is a challenge for plants in the rainforest, and they have adapted to survive in these conditions through various strategies, such as nutrient cycling and symbiotic relationships with other organisms. **Hence statement 3 is not correct.**
  - **Other Important Characteristics**
    - ✓ **They have broad or big leaves to help in transpiration.**
    - ✓ They are evergreen because the areas receive rainfall throughout the year. No shading leaves
    - ✓ They have small plants like mosses and algae which grow on stems, and branches because of wet conditions.
    - ✓ They have hardwood species, mvule, mahogany, ebony, musizi, rosewood, and ironwood.
    - ✓ They have a long gestation period of 30-50 years because they are hardwood species.
    - ✓ **They have limited or no undergrowth because of dense canopies.**
    - ✓ They have climbing plants like lianas, cucumbers, and epiphytes.
    - ✓ **The trees have no wax, but they have gum, glue, and rubber.**

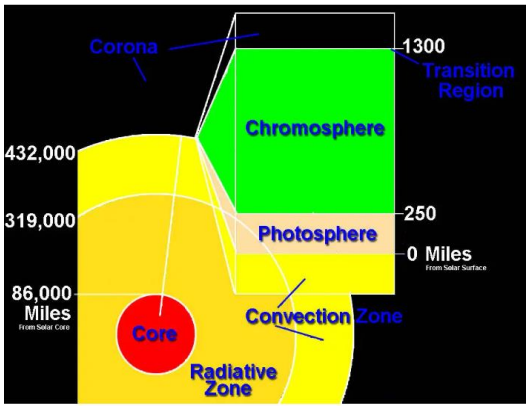
Q 88.B

- **The carbon cycle**
  - The carbon cycleis a biogeochemical cycle that involves the exchange of carbon atoms between the atmosphere, biosphere, pedosphere, geosphere, and hydrosphere. It is a crucial cycle that regulates the Earth's climate and supports the existence of life.
- **Key Components of the Carbon Cycle**
  - Reservoirs: The major reservoirs of carbon are the atmosphere, oceans, living organisms, and the Earth's crust.
  - Fluxes: Carbon moves between these reservoirs through various processes, including photosynthesis, respiration, decomposition, dissolution, and outgassing.
- **Natural processes that add carbon dioxide (CO2) to the carbon cycle:**
  - **Volcanic eruptions:** When volcanoes erupt, they release various gases into the atmosphere, including CO2, water vapor, and sulfur dioxide. Volcanic eruptions can release significant amounts of CO2, particularly from large, explosive eruptions.
  - **Respiration:** All living organisms, including plants, animals, and microorganisms, respire, releasing CO2 as a byproduct of their cellular metabolism. Respiration is an essential process for energy production, and it plays a crucial role in the carbon cycle.
  - **Decomposition:** When organic matter decomposes, it releases CO2 back into the atmosphere. This process is carried out by decomposers, such as bacteria and fungi, which break down dead plants and animals. Decomposition is a critical process in nutrient cycling and energy flow within ecosystems. **Hence option 2 is correct.**
  - **Forest fires:** Forest fires, both natural and human-caused, release CO2 into the atmosphere. Burning vegetation releases stored carbon, contributing to the increase of CO2 in the atmosphere. Forest fires can be particularly impactful in large forested areas, such as the Amazon rainforest.
  - **Ocean outgassing:** Oceans absorb CO2 from the atmosphere, but they also release CO2 back into the atmosphere through a process called outgassing. This exchange of CO2 between the atmosphere and the ocean is an important part of the carbon cycle.
  - **Weathering of rocks:** The weathering of rocks, particularly carbonate rocks, releases CO2 into the atmosphere. This process occurs slowly over time, but it contributes to the overall carbon budget. **Hence option 3 is correct.**
  - **Geothermal vents:** Geothermal vents, found in areas of volcanic activity, release various gases, including CO2, from deep within the Earth. These vents contribute to the ongoing exchange of carbon between the Earth's interior and the atmosphere.
- **Natural processes that absorb CO2 in the carbon cycle:**
  - **Photosynthesis:** Plants, algae, and some bacteria use photosynthesis to convert CO2 from the atmosphere into organic matter, such as glucose. This process removes CO2 from the atmosphere and stores it in plant tissues and soil.
  - **Ocean absorption:** The ocean absorbs CO2 from the atmosphere through a process called dissolution. This process removes CO2 from the atmosphere and stores it in the ocean.
  - **Rock formation:** When plants and animals die, their remains can become buried and eventually transformed into rocks. This process removes CO2 from the atmosphere and stores it in rocks.
  - **Sedimentation:** When sediments, such as sand and silt, are carried by rivers and streams, they can eventually settle and form new rocks. This process can remove CO2 from the atmosphere and store it in rocks. **Hence option 1 is not correct.**

Q 89.C

- Indian Space Research Organisation (ISRO) launched the **Aditya-L1 mission**. Aditya-L1 is **India's first dedicated mission to study the Sun**. The primary objective of the mission is to observe the **Sun's outermost layer, known as the corona,** and study various phenomena like **solar winds and magnetic fields associated with the Sun.**
- The Sun is composed of several layers, each with distinct characteristics and functions. These layers, from the interior to the outermost layer, are:
  - **Core:** The core is the **innermost layer** and is where **nuclear fusion occurs**. Here, intense heat and pressure cause hydrogen atoms to fuse into helium, releasing an enormous amount of energy in the form of light and heat.
  - **Radiative Zone:** Here energy produced in the core travels outward in the **form of photons of light.**
  - **Convection Zone**: In this layer**, energy is transported by the rising and falling of hot and cool material**. Hot plasma rises toward the surface, cools as it releases energy, and then descends back into the interior.

- **Photosphere:** The photosphere is the **visible surface of the Sun** that emits light and heat. It is the layer from which sunlight is directly radiated into space.
- **Chromosphere:** It is characterized by a **reddish glow and is typically seen during a solar eclipse.**
- **Transition Region**: The transition region is a **narrow layer between the chromosphere and the corona**. It is an area of rapid temperature increase.
- **Corona**: The **outermost layer is the corona,** an extremely hot and tenuous outer atmosphere that extends into space. The corona is **visible during a solar eclipse as a faint halo of plasma** around the Sun.



- Hence 2-1-3-5-4 is the correct sequence.
- **Hence option (c) is the correct answer.**

Q 90.D

- **Canyons** are **deep, narrow valleys with steep sides**, often carved by rivers or other natural processes. They are striking geological features that showcase the **erosive power of water and other forces over long periods.**
- **Subaerial canyons** refer to canyons that are formed primarily through erosion by processes that **occur above the water surface**, rather than through underwater processes. While many canyons are associated with rivers or bodies of water, subaerial canyons are shaped by various terrestrial factors. **Submarine canyons** are **underwater features** that resemble canyons on land but are carved **beneath the surface of the ocean.**
- **Subaerial canyons on land often have relatively straight courses**, Straighter courses are often associated with more **resistant rock types** that may be **less prone to meandering**.
- **Submarine canyons** typically exhibit **more sinuous or winding courses**. Turbidity currents, which are underwater currents carrying sediments, play a significant role in carving these canyons. **Turbidity currents** tend to follow the contours of the ocean floor, leading to sinuous paths as they transport sediments downslope. **Hence statement 1 is not correct.**
- The **gradient** refers to the slope or incline of the canyon walls, it is **influenced by the erosional processes and the type of material** through which the canyon is carved. The **gradient of submarine canyons is steeper than that of continental canyons**. **Hence statement 2 is not correct.**
- On the basis of morphogenetics canyons are classified into **glacial and non-glacial**. The **non-glacial submarine canyons are more numerous than the glacial canyons** and are widely spread in all the oceans. The majority of canyons on Earth are shaped by non-glacial processes, with rivers being a significant erosional force. **Hence statement 3 is not correct.**
- **Hence, option (d) is the correct answer.**

Q 91.C

- **The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal was adopted on 22 March 1989 by the Conference of Plenipotentiaries in Basel, Switzerland, in response to a public outcry following the discovery, in the 1980s, in Africa and other parts of the developing world of deposits of toxic wastes imported from abroad.**
- **The Bamako Convention is a treaty of African nations prohibiting the import into Africa of any hazardous (including radioactive) waste.** The convention came into force in 1998. The Bamako convention is a response to Article 11 of the Basel Convention which encourages parties to enter into bilateral, multilateral and regional agreements on Hazardous Waste to help achieve the objectives of the convention. To date, it has 29 Signatories and 25 Parties.

- 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 hazardous waste; the Convention also covers national definitions of hazardous waste. Other products also covered under the Convention as waste include that have been severely restricted or have been subject of prohibitions.
- **The Convention to Ban the Importation into Forum Island Countries of Hazardous and Radioactive Wastes and to Control the Transboundary Movement of Hazardous wastes within the South Pacific Region, known also as Waigani Convention, entered into force on the 21st October 2001.**
- The Convention to Ban the Importation into Forum Island Countries of Hazardous and Radioactive Wastes and to Control the Transboundary Movement of Hazardous wastes within the South Pacific Region, also known as Waigaini Convention, entered into force on the 21st October 2001. **Hence, option (c) is the correct answer.**

Q 92.A

- **Biotransformation technology is a novel approach to ensure plastics that escape refuse streams are processed efficiently and broken down.** The tech was co-developed by the Imperial College in London, UK, and a Britain-based startup, Polymateria.
- Plastics made using this technology are given a pre-programmed time during which the manufactured material looks and feels like conventional plastics without compromising on quality. **Once the product expires and is exposed to the external environment, it self-destructs and biotransforms into bioavailable wax. This wax is then consumed by microorganisms, converting waste into water, CO2, and biomass. Hence, option (a) is the correct answer.**
- Microorganisms then consume this wax, leading to the conversion of waste into water, carbon dioxide, and biomass. For plastics to undergo biodegradation, they must be consumed by microorganisms and converted into water, CO2, and biomass. The conditions for this process may vary based on the type of microorganisms involved in the cycle, ensuring a safe return to the environment. Polymateria has shown that the technology works in tropical, arid and temperate conditions, which is where roughly 90% of the world's population lives.
- The company claims that the biotransformation process of plastic starts quite quickly in nature. It begins to transform plastic into a wax over a period of 2 to 4 months, which may vary based on the climate.
- The technology can be used in many industries but will be particularly beneficial for the food and healthcare industry as they generate a significant proportion of plastic waste. Some companies are even using such technologies, but Biotransformation will work as a complete game changer in the efforts.
- At a time when the world is producing around 400 million tonnes of plastic waste every year, such technologies can go a long way in providing an environment-friendly alternative to the dangerous plastic. The world is waking up to the problem, and governments, industry, and other stakeholders are starting to act.

Q 93.C

- **Perform, Achieve and Trade (PAT) is a regulatory instrument to reduce Specific Energy Consumption in energy-intensive industries, with an associated market-based mechanism to enhance the cost-effectiveness through certification of excess energy saving which can be traded. Hence, statement 1 is correct.**
- **PAT is a mechanism for improvements in the energy efficiency of energy-intensive industries.** Specific high energy-intensive industries are identified as Designated Consumers (DCs) within certain key sectors, who are required to appoint an energy manager, file energy consumption returns every year and conduct mandatory energy audits regularly. The key tasks in the PAT mechanism is to set the methodology for deciding the Specific Energy Consumption (SEC) norms for each designated consumer in the baseline year and in the target years, devise a verification process for SEC, finding ways of issuing the Energy Savings Certificates, operationalization of the trading process for ESCerts in addition to the compliance and reconciliation process for ESCerts.
- **The creation of the PAT mechanism comes from the provisions of the Energy Conservation Act, 2001 which also empowers the Central Government to notify energy-intensive industries as listed out in the Schedule to the Act, as Designated Consumers (DCs). Hence, statement 2 is correct.**
- ESCerts are issued to those DCs who exceed their targets after verification by accredited energy auditors. One ESCert is equivalent to one metric tonne of oil equivalent (toe) energy saved by the DC over and above its target as per the baseline year production. **The DCs that do not meet the target are required to buy ESCerts equivalent to the additional energy consumed over and above their target as per the**

baseline year production. These ESCerts are electronic tradable instruments and can be traded on Indian Energy Exchange (IEX), Power Exchange India Limited (PXIL) or Hindustan Power Exchange Limited (HPX) in the designated period. DCs have two and a half years after the end of the target year to submit compliance by showing proof of purchase of mandated ESCerts. Hence, statement 3 is correct.

- It forms part of the National Mission for Enhanced Energy Efficiency (NMEEE) which is one of the eight missions of the National Action Plan on Climate Change (NAPCC).

Q 94.B

- **Recent Context: Sixty-three countries, including the US, Canada, and Kenya, signed up to the world's first-ever pledge to drastically cut cooling emissions at the recently concluded COP28 climate summit**
- **An initiative of the United Arab Emirates as host of the 2023 United Nations Climate Change Conference (COP28),** the Pledge is one of nine non-negotiated declarations, pledges, and charters that constitute key outcomes for the COP28 Presidential Action Agenda. **Hence, statement 1 is correct.**
- **It aims to raise ambition and international cooperation through collective global targets to reduce cooling related emissions by 68% by 2050 compared to 2022 levels, significantly increase access to sustainable cooling by 2030, and increase the global average efficiency of new air conditioners by 50%. T**he emission targets draw on the modelling from the UNEP Cool Coalition report Global Cooling Watch 2023 Keeping it Chill: How to meet cooling demands while cutting emissions. **Hence, statement 2 is correct.**
- **India did not join the pledge as it faces a unique challenge in balancing its aspirations for development and environmental sustainability.** A hot country already, climate projections indicate an up to sixfold increase in the frequency of severe heat waves by 2060. It poses a significant threat to its growing and vulnerable population.
- **It also has raised concerns about the principle of equity, emphasizing that developed countries, with their greater historical responsibility for greenhouse gas emissions, should bear a larger burden in emissions reduction efforts. Hence, statement 3 is not correct.**

Q 95.C

- **Recent Context:** Almost $7 trillion is invested by countries every year in subsidies and private investments that have a direct negative impact on nature, according to a **new United Nations report 'State of Finance for Nature'.** The figure is equivalent to 7 percent of the global gross domestic product.
- **The report, presented by the UN Environment Portal (UNEP) at the 28th Conference of Parties (COP28) to the United Nations Framework Convention on Climate Change, analyses and quantifies the private finance flows that directly affect nature negatively for the first time. Hence, option (c) is the correct answer.**
- The State of Finance for Nature annual report series tracks finance flows to nature-based solutions (NbS) and compares them to the finance needed to maximize the potential of Nature-based Solutions to help tackle climate, biodiversity and degradation challenges.
- The analysis identified five industries influencing most of the negative financial flows, which are: Construction, electric utilities, real estate, oil and gas, and food and tobacco. The industries contributed about 16 percent of overall investment flows in the economy. However, 43 percent of financing that harmed nature were associated with the destruction of forests, wetlands, and other natural habitats.
- Further, it noted that the global fossil fuel subsidies to consumers doubled between 2021 and 2022, increasing from $563 billion to $1.16 trillion, accelerated by the subsidies issued to protect consumers from Russia's invasion of Ukraine.
- **The report focuses on current levels of NbS implementation and finance and how much finance for NbS is needed to reach specific Rio targets – limit climate change to 1.5°C, protect 30 percent of land and sea by 2030 (30x30 target) and reach land degradation neutrality (LDN) by 2030. The NbS finance gap is the difference between current finance flows and the Rio-aligned scenario NbS finance needs.**

Q 96.C

- **Recent Context:** A five-judge Constitution bench of the Supreme Court, on December 5, began hearing pleas challenging Section 6A of the Citizenship Act, which was introduced in the statute following the signing of the Assam Accord.

- **Section 6A of the Citizenship Act is a special provision on the citizenship of persons covered by the Assam Accord. Under this section, people who entered India between January 1, 1966, and March 25, 1971, and have been living in Assam, will be allowed to register themselves as citizens. Hence, statement 1 is correct.**
- **Section 6A was inserted into the 1955 Citizenship Act in December 1985. Assam is the only state in India to have an exclusive cut-off date for citizenship. For the rest of the country, the cut-off date is July 19, 1949. Hence, statement 2 is not correct but statement 3 is correct.**
- The plea before the bench, while questioning the constitutional validity of Section 6A, wants 1951 to be established as the cut-off date for inclusion in the National Register of Citizens instead of 1971.
- The core argument in the petition is that by establishing a different cut-off date for Indian citizenship in Assam than in the rest of India — which is July 1948 — Section 6 A is "discriminatory, arbitrary and illegal" and violative of the rights of "indigenous" Assamese people.

Q 97.B

- **Saline soils contain a larger proportion of sodium, potassium, and magnesium, and thus, they are infertile and do not support any vegetative growth. They are also known as Usara soils.**
- They have more salts, largely because of dry climate and poor drainage. **They occur in arid and semi-arid regions, and in waterlogged and swampy areas.**
- Their structure ranges from sandy to loamy. They lack nitrogen and calcium. **Saline soils are more widespread in western Gujarat, deltas of the eastern coast, and in Sunderban areas of West Bengal.**
    - In the Rann of Kuchchh, the Southwest Monsoon brings salt particles and deposits there as a crust. Seawater intrusions in the deltas promote the occurrence of saline soils.
- In the areas of intensive cultivation with excessive use of irrigation, especially in areas of green revolution, the fertile alluvial soils are becoming saline.
- Excessive irrigation with dry climatic conditions promotes capillary action, which results in the deposition of salt on the top layer of the soil. In such areas, especially in Punjab and Haryana, farmers are advised to add gypsum to solve the problem of salinity in the soil.
- **Hence option (b) is the correct answer.**

Q 98.C

- **The Zabarwan Range is a short sub-mountain range between Pir Panjal and the Great Himalayan Range in the central part of the Kashmir Valley in the Union Territory of Jammu and Kashmir in India.**
- The Zabarwan Range is situated to the northeast of Srinagar, the summer capital of the Indian-administered union territory of Jammu and Kashmir. **This range affects the climate of the region by influencing precipitation patterns and providing a stunning landscape in the Kashmir Valley.**
- **The climate of the Zabarwan Mountain Range can be summed up with the climate of Dachigam. It is a sub-Mediterranean type**, with two spells of dryness from April to June and September to November.
    - The range has irregular weather conditions with a considerable variation in the amount of precipitation.
    - Snow is the main source of precipitation and in some parts melts till June.
    - The annual minimum and maximum rainfall of the Zabarwan Mountain Range ranges between 32 mm to 546 mm.
- **Hence option (c) is the correct answer.**

Q 99.C

- Cotton is a "pure" raw material which does not lose weight in the manufacturing process. so factors, like, power to drive the looms, labour, capital or market may determine the location of the industry. At present the trend is to locate the industry at or close to markets, as it is the market that decides what kind of cloth is to be produced. Also, the market for the finished products is extremely variable, therefore, it becomes important to locate the mills close to the market.
- In recent years, cotton textile mills are shifted away from traditional centres of cotton producing areas. Because of the following reasons:
- **The development of hydroelectricity also favoured the location of the cotton textile mills away from the cotton producing areas.** The rapid development of this industry in Tamil Nadu is the result of the abundant availability of hydel power for the mills.
- **Lower labour costs** at centres like Ujjain, Bharuch, Agra, Hathras, Coimbatore and Tirunelveli also caused industries to be located away from cotton-producing areas.

- Mills were also set up at Kolkata due to its port facilities.
- **Cotton textile mills were set up at Kanpur based on local investment.** Thus, the cotton textile industry is located in almost every state in India, where one or more of the locational factors have been favourable.
- **Hence option (c) is the correct answer.**

Q 100.A

- **The Malwa Plateau roughly forms a triangle based on the Vindhyan Hills, bounded by the Aravali Range in the west and a sharply defined scarp overlooking Bundelkhand in the east.**
- **The plateau inherits a complex geology; scarcely any one of the peninsular groups is unrepresented here. This plateau has two systems of drainage; one towards the Arabian Sea (The Narmada, the Tapi, and the Mahi), and the other towards the Bay of Bengal (Chambal and Betwa, joining the Yamuna).**
- With a length of 530 km and a width of 390 km, it spreads over an area of 1,50,000 sg km. In the north, it is drained by the Chambal and many of its right-bank tributaries like the Kali, the Sindh, and the Parbati.
- It also includes the upper courses of the Sindh, the Ken, and the Betwa. It is composed of extensive lava flow and is covered with black soil.
- The general height decreases from 600 m in the south to less than 500 m in the north.
- There are colling surfaces and flat-topped hills dissected by rivers flowing through the area. In the north, the plateau is marked by the Chambal ravines.
- **Hence option (a) is the correct answer.**