

ANSWERS & EXPLANATIONS GENERAL STUDIES (P) TEST – 4141 (2024)

Q 1.B

- The river Son is an important right-bank tributary of the river Ganga. It originates from Amarkantak highlands in the hills of the Maikala range in the Bilaspur district of Chhattisgarh at an elevation of 640 m, latitude of 20°44' N, and longitude of 82°4'E. The river outfalls into the Ganga at about 16 km. upstream of Patna at latitude 25°14' N and longitude 84°42' E. The total length of the river is 881 km. The total catchment area of the river system is 70,055 sq. km. **Hence, statement 1 is correct**
- From Amarkantak, Madhya Pradesh, the river flows in the north-northwest direction through the Shahdol district of Madhya Pradesh before turning toward the east direction where it meets the southwest-northeast Kaimur Range. **The Son River flows through the states of Madhya Pradesh, Chhattisgarh, Uttar Pradesh, Jharkhand, and Bihar. Hence, statement 2 is not correct.**
- Gharials are found in the Son River and the river has been in the news due to a reduction in the number of Gharials for quite some time. In 1981, 161 kilometers around the Son River were declared a wildlife sanctuary to protect the endangered gharials among other animals. **The number of gharials, however, has been on the decline since then: It came down to 20 in 2021 (all female) from 72 in 2016. Hence, statement 3 is correct.**
- Recently, the National Green Tribunal said that no sand mining will be allowed on the banks of the Son River.

Q 2.C

- **Isotherms**, lines connecting points of equal air temperature are used to map the geographic temperature pattern across the earth's surface. **The spacing of isotherms depicts the temperature gradient across a portion of the Earth's surface. Widely spaced isotherms indicate a small change in temperature over distance and closely spaced isotherms indicate large changes in temperature. Hence both Statements 1 and 2 are correct.**
- The shape of isotherms, as they appear on a map, is influenced by the distribution of large land masses and water bodies and the time of the year.
- **Temperature gradients are usually low (isotherms are widely spaced) over the eastern margins of continents because of warm ocean currents.**
- **While passing through an area with warm ocean currents, the isotherms show a poleward shift.** E.g. North Atlantic Drift and Gulf Stream in the Northern Atlantic; Kurishino Current and North Pacific Current combined in the Northern Pacific.
- Temperature gradients are **usually high (isotherms are closely spaced) over the western margins of continents** because of cold ocean currents.
 - The cold currents are usually found on the west coast of the continents in the high and middle latitudes in both hemispheres. E.g. Benguela, Canary, California, Alaska, and Peru Current etc.
- Isotherms bend much more between seasons in the Northern Hemisphere than in the Southern Hemisphere. The Southern Hemisphere is more uniformly water than the Northern Hemisphere. Large landmasses in the Northern Hemisphere cause isotherms to bend toward the equator in winter and poles in summer as they change their temperature much more than the water. Air temperatures over land fluctuate more because land changes its temperature much more rapidly than ocean water. Thus they shift north and south much more over land through the year than they do over water.

Q 3.A

- **Peaty Soils:** The accumulation of a high number of organic matter in the soil in humid regions results in the formation of peaty soils. **These types of soils constitute about 10 to 40% of the organic matter and also a reasonable number of soluble salts. Peaty soils are heavy, black, and have high acidic content. They are low in phosphate and potash content.** Peaty and marshy soils are found in a few districts of

Kerala. On the other hand, marshy soils are found in coastal areas of some states such as Tamil Nadu, Bihar, Almora district of Uttarakhand, and Sundarbans of West Bengal. Hence, option (a) is the correct answer.

- **Saline Soils:** They are also known as Usara soils. Saline soils contain a larger proportion of sodium, potassium and magnesium, and thus, they are infertile and do not support any vegetative growth. 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 in 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 Kutch, 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.
- **Alluvial soils** are widespread in the northern plains and the river valleys. These soils cover about 40 per cent of the total area of the country. They are depositional soils, transported and deposited by rivers and streams. Through a narrow corridor in Rajasthan, they extend into the plains of Gujarat. In the Peninsular region, they are found in deltas on the east coast and in the river valleys. The alluvial soils vary in nature from sandy loam to clay. They are generally rich in potash but poor in phosphorous. In the Upper and Middle Ganga plain, two different types of alluvial soils have developed, viz. Khadar and Bhangar. Khadar is the new alluvium and is deposited by floods annually, which enriches the soil by depositing fine silts. Bhangar represents a system of older alluvium, deposited away from the flood plains. Both the Khadar and Bhangar soils contain calcareous concretions (Kankars). These soils are more loamy and clayey in the lower and middle Ganga plain and the Brahmaputra valley. The sand content decreases from the west to the east. The colour of the alluvial soils varies from light grey to ash grey. Its shades depend on the depth of the deposition, the texture of the materials, and the time taken for attaining maturity. Alluvial soils are intensively cultivated.
- **Arid soils** range from red to brown in colour. They are generally sandy in structure and saline in nature. In some areas, the salt content is so high that common salt is obtained by evaporating the saline water. Due to the dry climate, high temperature and accelerated evaporation, they lack moisture and humus. Nitrogen is insufficient and the phosphate

Q 4.D

- The months of October and November are known for retreating monsoons. By the middle of September, the southwest monsoon becomes weak as a low-pressure trough of the Ganga plain starts moving southward in response to the southward march of the Sun. Retreating monsoon season is marked by clear skies and a rise in temperature. The land is still moist. Owing to the conditions of high temperature and humidity, the weather becomes rather oppressive. This is commonly known as the 'October heat'.
- In the second half of October, the mercury begins to fall rapidly, particularly in northern India. In the first half of October, major parts of the country experience an average temperature ranging between 25°C to 28°C. Rajasthan, Gujarat, and the coastal plains of East coast experience temperatures of about 28°C. As the monsoon starts retreating towards the south, the pressure gradient becomes low. Local pressure conditions usually affect the wind flow during that time.
- It is during the retreating monsoon season in India that the southeastern coast receives a lot of rainfall. Tropical cyclones also occur during this time. The state of Tamil Nadu receives almost half of its annual rainfall during this time. This is called the winter monsoon or the northeast monsoon. Hence, option (d) is the correct answer.

Q 5.D

- A solar eclipse occurs when the Moon passes between the Earth and the Sun, blocking some or all of the Sun's light from reaching the Earth. This celestial event creates a temporary darkening of the sky during daylight hours. There are three main types of solar eclipses:
 - Total Solar Eclipse: In a total solar eclipse, the Moon completely covers the Sun, casting a shadow on a specific region of the Earth. This region experiences temporary darkness during the eclipse. Total solar eclipses are relatively rare and can only be observed along a narrow path on Earth.
 - Partial Solar Eclipse: In a partial solar eclipse, the Moon partially covers the Sun's disk when viewed from Earth. This creates a crescent-shaped appearance as the Moon passes in front of the Sun. Partial solar eclipses are more common and can be observed from a broader geographic area.

- Annular Solar Eclipse: An annular solar eclipse occurs when the Moon covers the central part of the Sun, leaving a ring or "annulus" of the Sun's disk visible around the edges. This happens when the Moon is near its apogee (farthest from Earth), and its apparent size is smaller than that of the Sun. Annular eclipses are less common than partial eclipses.
- **Maximum number of solar eclipses (partial, annular, or total) is 5 per year is generally accurate. Some years may have fewer, while others may have more, depending on the alignment of the Earth, Moon, and Sun. Hence statement 1 is not correct.**
- The specific number of eclipses in a given year can be calculated based on celestial mechanics and the geometry of the Earth-Moon-Sun system.
- While it is possible to have up to 5 solar eclipses in a single year, this is not an everyday occurrence, and it can vary from year to year. The majority of eclipses in any given year are likely to be partial eclipses.
- **Earth's orbit around the Sun is indeed elliptical in shape.** This means that the distance between Earth and the Sun varies slightly throughout the year. **Hence statement 2 is correct.**
- At its closest point to the Sun (perihelion), Earth is about 147 million kilometers (91.4 million miles) away, while at its farthest point (aphelion), it is about 152 million kilometers (94.5 million miles) away. This variation in distance is one of the factors contributing to the changing seasons on Earth.

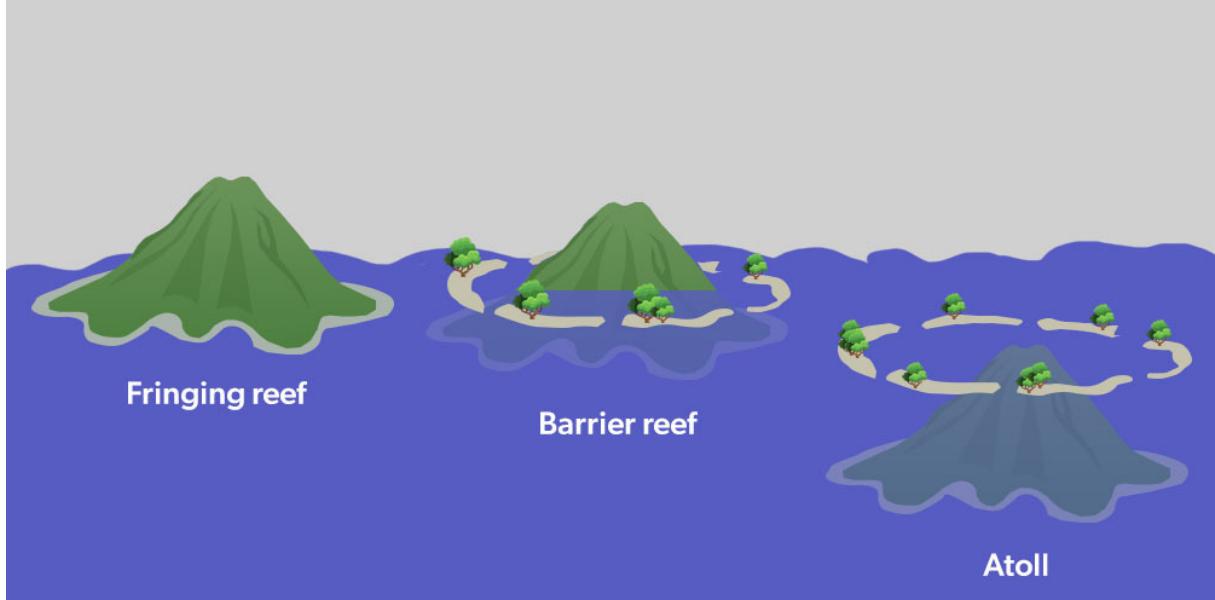
Q 6.B

- **Defence Acquisition Council (DAC) has accorded Acceptance of Necessity (AoN) for nine capital acquisition proposals of approx. Rs 45,000 crore.** The meeting was held under the chairmanship of Raksha Mantri Shri Rajnath Singh on September 15, 2023.
- All these procurements will be made from Indian vendors under Buy (Indian-Indigenously Designed Developed and Manufactured (IDMM)/Buy (Indian) category which will give substantial boost to the Indian defence Industry towards achieving the goal of 'Aatmanirbhar Bharat'.
- **The DAC is highest decision-making body for defence procurements headed by the Defence Minister.** It gives 'in principle' approval to Capital acquisitions for the forces. Approved procurements includes Dhruvastra Short Range Air-to-Surface Missile, light armoured multipurpose vehicles, etc to modernise its armed forces. **Hence, statement 2 is not correct.**
- About Defence Acquisition Council (DAC):
- The DAC is the highest decision-making body of the defence Ministry on procurement. The objective is to ensure expeditious procurement of the approved requirements of the armed forces. **It was formed after the Group of Minister's recommendations on 'Reforming the National Security System', in 2001, post-Kargil War (1999). Hence, statement 1 is correct.**
- **The defence minister is the chairman of DAC.** Its members include the Chief of Defence Staff (CDS) and chiefs of the Army, Navy, and Air Force.
- **It decides on new policies and capital acquisitions for the three services – Army, Navy and Air Force, and the Indian Coast Guard.** Hence, statement 3 is correct.

Q 7.C

- Coral reefs are underwater structures that are made up of colonies of tiny animals called coral polyps. These structures are found in shallow, warm, and clear waters, typically in tropical and subtropical regions.
- Coral polyps are small, soft-bodied organisms that are related to jellyfish and sea anemones. They have a hard external skeleton made of calcium carbonate, which forms the base of the reef. As new generations of coral polyps grow and reproduce, they add to the existing skeleton, slowly creating the complex and intricate structures that we see as coral reefs.
- There are three main types of coral reefs.
 - **Fringing reefs:** A fringing reef is a coralline platform lying close to the shore extending outwards from the mainland.
 - ✓ It is sometimes separated from the shore by a shallow lagoon. It is widest when fringing a protruding headland but completely absent when facing the mouth of a stream. The outer edge grows rapidly because of the splashing waves that continuously renew the supply of fresh food. **Hence statement 1 is correct.**
 - **Barrier reefs**
 - ✓ A barrier reef is separated from the coast by a much wider and deeper channel or lagoon.
 - ✓ The reef is partially submerged. Where it lies above the water level and sand can accumulate on it, a little vegetation is possible.

- ✓ The barrier reefs have narrow gaps at several places to allow the water from the enclosed lagoon to return to the open ocean. Such gaps are very useful for shipping and provide the only entrances for ships to enter or leave the lagoon.
- ✓ The best-known barrier reef is the Great Barrier Reef off the coast of Queensland, Australia. **Hence statement 2 is correct.**
- **Atolls**
 - ✓ Atolls are similar to barrier reefs except that they are circular in shape, **enclosing a shallow lagoon without any land in the center**. The encircling ring is usually broken in a few places to allow the free flow of water. On the inside of the reefs, sand and limestone debris collect and palm trees like coconuts may grow. **Hence statement 3 is correct.**



Q 8.A

- **Western Disturbances are cyclonic storms that form over land, and they occur mostly in the Mediterranean region due to a temperature gradient caused by the mixing of warm air from the tropics and cold air from the northern polar regions.**
- **A Western Disturbance is in the shape of a spiral with a narrow mouth at the bottom (formed at a height of about 5,500 meters above sea level) and a wide mouth at the top (formed at a height of more than 9,000 meters above sea level).**
- While the storm systems occur throughout the year, they travel to India mostly between December and April because the trajectory of the subtropical westerly jet stream, which transports them, shifts during the winter months to the rim of the Himalayas.
- For the rest of the year, the jet stream travels from above the Himalayas to the Tibetan Plateau and China. The trajectory of the jet stream changes as per the position of the Sun.
- The jet stream appears over northern India in October after the withdrawal of monsoon and shifts progressively southwards in the winter months. It reaches its southernmost position in February and moves out of the subcontinent after May.
- For the past three years, the world has been in a La Niña phase, which refers to the cooling of ocean surface temperature in the Pacific Ocean. It weakens the temperature gradient for the formation of Western Disturbances as it reduces the temperature of the hot tropical air.
- **The northward shift of the subtropical westerly jet stream is one of the significant reasons for the weakening of western disturbances as a result. They are moving a little bit further away from the Arabian Sea, so they have a little bit less access to that moisture channel. Such a shift not only reduces the chance of Western Disturbances striking India but also increases the chance of them affecting higher latitudes such as the Tibetan Plateau or even as far up as China and Russia. Hence, statement I and II are correct and statement II is the correct explanation for statement I.**
- This could indirectly affect the southwest monsoon, which accounts for 80 percent of India's annual rainfall. Snow reflects most of the Sun's rays falling on it and stops the land from heating up. This phenomenon is called the albedo effect. If there is excessive snowfall over the Tibetan plateau then it would not get as warm as it should, and this would hamper the incoming monsoon winds in June.

Q 9.B

- The primary source of oxygen during the "Great Oxygenation Event" (GOE), which occurred in the Precambrian Era, was cyanobacteria.
- Cyanobacteria, also known as blue-green algae, were some of the earliest photosynthetic organisms on Earth. They had the ability to perform photosynthesis, a process by which they used sunlight, water, and carbon dioxide to produce energy and release oxygen as a byproduct.
- Before the GOE, Earth's atmosphere had very little oxygen, and the dominant gases were carbon dioxide (CO₂), methane (CH₄), and nitrogen (N₂). However, as cyanobacteria evolved and proliferated, they began to release significant amounts of oxygen into the environment through photosynthesis.
- This oxygen gradually accumulated in the atmosphere, leading to the transformation of Earth's environment and ecosystems. The rise of oxygen in the atmosphere had profound effects on the planet.
 - It contributed to the formation of an ozone layer (O₃) in the upper atmosphere, which provided protection against harmful ultraviolet (UV) radiation from the Sun.
 - This allowed life to move from the oceans onto land, as well as the development of more complex and aerobic (oxygen-dependent) life forms.
- The GOE fundamentally changed the chemistry of Earth's atmosphere and set the stage for the evolution of life as we know it today.
- **Hence option (b) is the correct answer.**

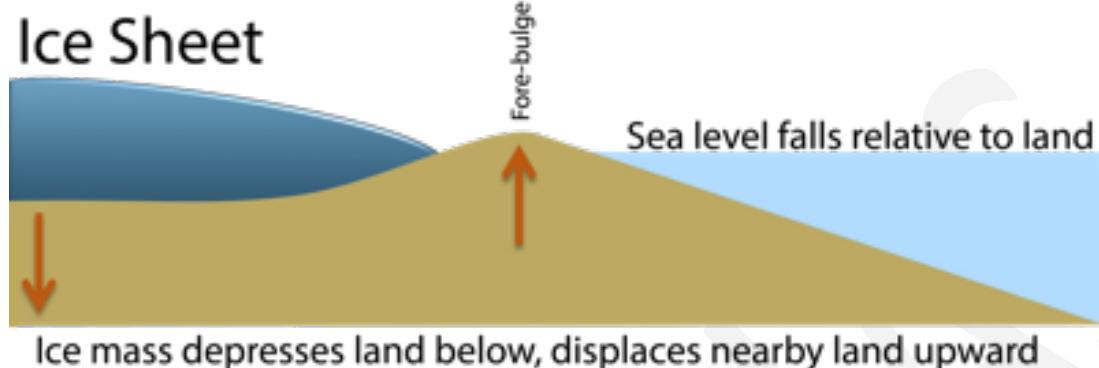
Q 10.C

- Precipitation in India is irregular over the course of a year, with a well-defined rainy season over most of the country starting in about June and ending in September. The following is the distribution of rainfall in India:
- **Extreme precipitation regions:** North-eastern states and the windward side of Western Ghats experience an average of 300-400 cm of annual rainfall. States like Assam, Meghalaya, Arunachal Pradesh, and hilly tracts of Western Ghats are host to tropical rainforests. However, the highest rainfall exceeding 400 cm in India and the world is recorded at Mawsynram village of Meghalaya. Hence, pair 1 is correctly matched.
- **Heavy precipitation regions:** Areas experiencing 200-300 cm of rainfall belong to this zone. Most of Eastern India is covered under this zone. These regions are also home to tropical rainforests. States such as West Bengal, Tripura, Nagaland, Manipur, Odisha and Bihar are included in this zone. Most of the areas in the sub-Himalayan belt also fall under this zone. Hence, pair 2 is correctly matched.
- **Moderate precipitation regions:** Areas that experience 100 to 200 cm of rainfall include parts of West Bengal, Bihar, Odisha, Madhya Pradesh, Andhra Pradesh, and the leeward side of Western Ghats. Wet Deciduous forests comprise the most common natural vegetation of these regions. Hence, pair 3 is correctly matched.
- **Scanty precipitation regions:** Areas having 50 to 100 cm of rainfall consisting of parts of Maharashtra, Gujarat, Karnataka, Tamil Nadu, Andhra Pradesh, Madhya Pradesh, Punjab, Haryana and Western Uttar Pradesh. Tropical grasslands, savannahs and dry deciduous forests are commonly found in these areas.
- Desert and semi-desert regions: These are the areas that receive below 50 cm of rainfall. The states of Rajasthan, Gujarat and adjacent areas are classified as desert or semi-desert based on the amount of rainfall they receive. Some parts of Jammu and Kashmir such as the Ladakh plateau are also included in this zone as cold deserts. The vegetation consists of hardy species which can withstand extended droughts. Some areas like parts of Gujarat have Savannah vegetation in the wetter regions. The lowest rainfall in India has been recorded in Ruyli village, Rajasthan.

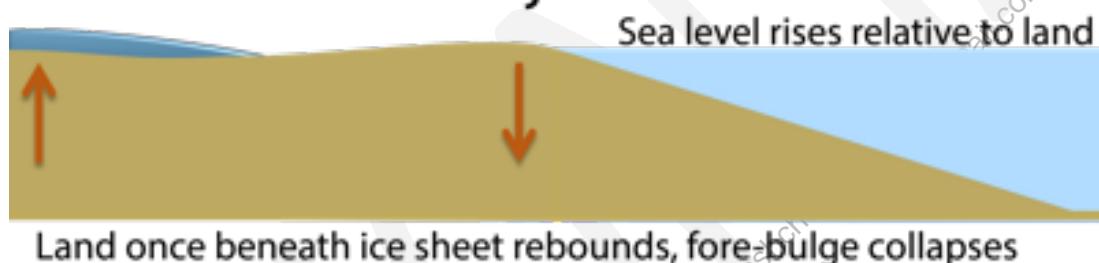
Q 11.C

- **Isostasy** is a geological concept that explains the balance of the Earth's lithosphere (the rigid outer layer of the Earth) on the semi-fluid asthenosphere (a partially molten layer beneath the lithosphere). It is a fundamental principle in geology that helps us understand how the Earth's crust responds to the distribution of mass on its surface.
- **The primary driving force behind isostatic adjustments in the Earth's crust is the balance between buoyant forces and gravitational forces.**
- Isostatic adjustments occur because of the principle that less dense materials, such as the Earth's crust (lithosphere), will float on top of denser materials, like the semi-fluid asthenosphere beneath it. This balance is crucial to maintaining isostatic equilibrium.

- When there are changes in the distribution of mass on the Earth's surface, such as the addition or removal of material (e.g., due to erosion, sediment deposition, or the melting of ice sheets), the weight or load on the lithosphere changes.
 - As a result, the lithosphere undergoes vertical adjustments to maintain equilibrium with the buoyant force exerted by the denser asthenosphere. These adjustments involve either subsidence (sinking) or uplift (rising) of the crust, depending on the nature of the mass changes.
- In the case of isostatic rebound, for example, when large ice sheets melt after an ice age, the removal of the ice mass reduces the load on the lithosphere. In response, the crust slowly rises or rebounds to its former elevation over geological time, driven by the buoyant force of the underlying asthenosphere.



Glacial Isostatic Adjustment



- Hence option (c) is the correct answer.

Q 12.C

- Chennai and Hyderabad differ in weather primarily due to their geographical locations, local topography, Elevation, etc.
- Geographical Location:** Chennai is located along the Bay of Bengal. It has a maritime climate, influenced by the nearby sea. Hyderabad, on the other hand, is located inland, away from the coast. It has a more continental climate, with less influence from the ocean. **Hence, option (c) is the correct answer.**
- Elevation:** Hyderabad is situated at a higher elevation compared to Chennai. The elevation of Hyderabad ranges from 500 to 600 meters above sea level, which can contribute to cooler temperatures, especially at night.
- Topography:** Chennai has a relatively flat topography, while Hyderabad has a more varied terrain with some hilly areas. The topographical differences can influence local wind patterns and temperature variations.
- Monsoon Influence:** Chennai experiences a strong influence of the Indian monsoon. Hyderabad also experiences the Indian monsoon but to a lesser extent
- Factors Affecting Temperature:** Temperature is influenced by a wide range of factors, both natural and human-made.
 - Latitude:** Temperature tends to decrease as one moves away from the equator (toward the poles).
 - Altitude (Elevation):** Temperature tends to decrease with an increase in altitude.
 - Proximity to Water Bodies:** Large bodies of water, such as oceans and seas, have a moderating effect on temperature.
 - Ocean Currents:** Warm Ocean currents can raise temperatures in coastal areas, while cold currents can have a cooling effect.
 - Prevailing Winds:** onshore winds from a warm body of water can raise coastal temperatures, while offshore winds can bring colder air from inland regions.

- **Topography and Geography:** The local terrain, such as mountains, valleys, and urban areas, can influence temperature. Mountains can block or funnel air masses, leading to temperature variations on the windward and leeward sides.
- **Longitude does not have a direct impact on temperature variation. It primarily affects time zones rather than temperature**

Q 13.A

- The Himalayas form a highly rugged and continuous stretch of high mountainous country, which flanks northern India for a considerable length and runs from the Brahmaputra gorge in the east to the Indus in the west. They cover an area of nearly 2,500 km. in length and 150 to 400 km. in width. Rising abruptly from the plains, the Himalayas rest against the Ladakh district of Jammu and Kashmir and the Tibetan Plateau in the form of an arc-like rim.
- **Shivalik range has low parallel ridges made up mainly of boulders and clay and these ridges are the foothills of the Himalayas.** The height of these ridges usually does not exceed 1,220 metres. Most of these ridges had formed after the formation of the Himalayas, thus they obstructed the courses of the rivers draining to the south and west and created temporary lakes in which debris brought by those rivers was deposited. **As the rivers had cut their courses through the Siwalik Range, the lakes were drained leaving behind plains called Duns. One such plain formed as a result of the draining of lakes is Dehra Dun (600 metres above sea level), in Uttarakhand. Hence, statement 1 is not correct.**
- Also known as Himadri, the Great Himalayan range is the longest continuous range among the Himalayas. It is also the highest range in the world with an average height of 6100 meters. The top of this range is about 25 km, wide, and is dotted with numerous snowy peaks. **The highest peak of the world, Mount Everest (8848 metres), is situated at the northern border of Nepal. The other notable peaks in descending order are Kanchenjunga (8598 metres; located in Sikkim in the Eastern Himalayas and not the Shivaliks), Makalu (8481 metres), Dhaulagiri (8172 metres) and Nanga Parbat (8126 metres).** In the west, the Great Himalaya ends in Nanga Parbat (8126 metres) whereas in the east it culminates in Namcha Barwa (7756 metres) close to the Brahmaputra in Tibet (the Brahmaputra is known as the Dihang, in this section of the Himalayas). **Hence, statement 2 is not correct but statement 3 is correct.**

Q 14.A

- When the moisture is deposited in the form of water droplets on cooler surfaces of solid objects (rather than nuclei in air above the surface) such as stones, grass blades and plant leaves, it is known as dew.
- **The ideal conditions for its formation are clear sky, calm air, high relative humidity, and cold and long nights.**
 - Clear sky: A clear sky allows for maximum radiative cooling, which causes the surface temperature to cool more quickly, increasing the likelihood of the air around it to reach its dew point.
 - Calm air: Calm air reduces the amount of mixing in the atmosphere, allowing for a layer of cool, moist air to form near the surface, which increases the likelihood of the air reaching its dew point.
 - High relative humidity: High relative humidity means that the air is already close to being saturated with water vapor, making it more likely to reach its dew point temperature and form dew.
 - Cold temperatures: The cooler the temperature, the more likely the surface temperature will reach the dew point temperature of the surrounding air, causing dew to form.
 - Long nights: Longer nights allow for more time for the surface to cool, increasing the likelihood of the air reaching its dew point temperature and causing dew to form
 - **Hence statement 1 is correct.**
- **For the formation of dew, it is necessary that the dew point is above the freezing point.**
 - If the temperature of the surface is below the freezing point, the water vapor in the air will freeze directly onto the surface as frost, rather than condensing into liquid droplets as dew. Therefore, for dew to form, the temperature of the surface must be above the freezing point of water.
 - **Hence statement 2 is not correct.**

Q 15.A

- Koppen divided India into nine climatic regions which are as follows:
 - **Monsoon type with short dry winter season(Amw): This climate is found in the western coastal region, south of Mumbai. This area receives over 300 cm of annual rainfall in summer from the south-west monsoons. Hence, option (a) is the correct answer.**
 - **Monsoon type with dry season in high sun period (As):** This is the region in which rainfall occurs in winter and summer is dry. The Coromandel coast experiences this type of climate. Coastal Tamil

Nadu and adjoining areas of Andhra Pradesh are included in it. The amount of rainfall, mostly in winter is 75-100 cm and is received from the retreating monsoons.

- **Tropical Savanah type(Aw):** This climate is found in most parts of the peninsular plateau barring Coromandel and Malabar coastal strips. The northern boundary of this climatic region roughly coincides with the Tropic of Cancer. The average annual rainfall is about 75 cm which is received in the summer season from the southwest monsoons. The winter season remains dry.
- **Semi-arid Steppe type(BShw):** Some rainshadow areas of Western Ghats, large parts of Rajasthan and contiguous areas of Haryana and Gujarat have this type of climate. Rainfall varies from 12 to 25 cm and most of it occurs in summer. Winter is completely dry. Some arid steppe vegetation is found here.
- **Hot desert type (BWhw):** Most of western Rajasthan has a hot desert type of climate where the amount of annual rainfall is less than 12 cm. Temperatures are very high in summer. Natural vegetation is almost absent.
- **Monsoon type with dry winters (Cwg):** This type of climate is found in most parts of the Ganga Plain, eastern Rajasthan, Assam and in Malwa Plateau. The summer temperature rises to 40°C which falls to 27°C in winter. Most rainfall occurs in summer and winter is dry.
- **Cold, Humid winters type with shorter summers (Dfc):** Some of the northeastern states such as Sikkim, Arunachal Pradesh and parts of Assam have this type of climate. Winters are cold, humid and of longer duration. The winter temperatures are about 10°C. Summers are short but humid.
- **Tundra Type(Et):** This climate is found in the mountain areas of Uttarakhand. The average temperature varies from 0 to 10°C. There is a fall in temperature with altitude.
- **Polar Type(E):** The higher areas of Jammu & Kashmir and Himachal Pradesh experience a polar climate in which the temperature of the warmest month varies from 0° to 10°C. These areas are covered with snow for most part of the year.

Q 16.B

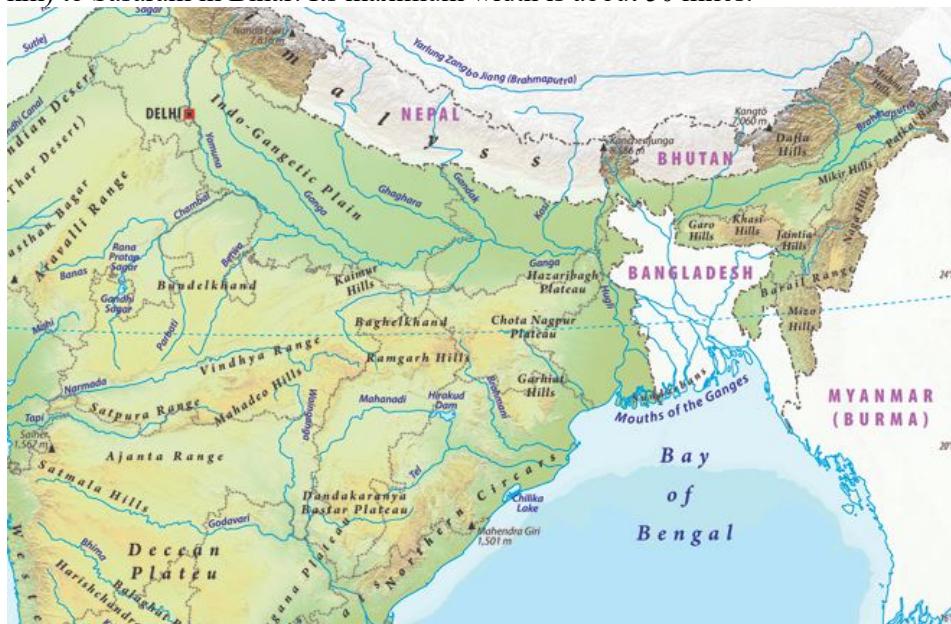
- **Earth's orbital period, often referred to as its "year," is approximately 365.25 Earth days. This is the time it takes for Earth to complete one orbit around the Sun.**
- Planets that orbit closer to the Sun than Earth have shorter years than Earth. Planets that orbit farther from the Sun than Earth have longer years than Earth.
- Mercury: Approximately 88 Earth days - Mercury has the shortest year among the planets in our solar system. It orbits the Sun relatively quickly due to its proximity to the Sun.
- **Venus: Approximately 225 Earth days** - Venus has an orbital period of about 225 Earth days, making its year a bit longer than Earth's.
- **Mars: Approximately 687 Earth days** - Mars has a longer orbital period, with a year lasting about 687 Earth days, which is roughly twice as long as Earth's year.
- **Jupiter: Approximately 4,333 Earth days (about 11.9 Earth years)** - Jupiter's year is significantly longer than Earth's, lasting almost 12 Earth years.
- Saturn: Approximately 10,747 Earth days (about 29.5 Earth years) - Saturn's year is even longer, spanning nearly 30 Earth years.
- Uranus: Approximately 30,589 Earth days (about 84 Earth years) - Uranus has an orbital period of about 84 Earth years, making its year much longer than Earth's.
- Neptune: Approximately 59,800 Earth days (about 164.8 Earth years) - Neptune has the longest orbital period among the planets, with a year lasting nearly 165 Earth years.
- **Hence option (b) is the correct answer.**

Q 17.B

- The monsoon rainfall has a declining trend with increasing distance from the sea. Kolkata receives 119 cm during the southwest monsoon period, Patna 105 cm, Allahabad 76 cm, and Delhi 56 cm. **Hence statement 1 is not correct.**
- A characteristic feature of rainfall in India is its variability. Variability of Rainfall is less than 25 percent exists on the western coasts, Western Ghats, northeastern Peninsula, eastern plains of the Ganga, northeastern India, Uttarakhand and Himachal Pradesh and the south-western part of Jammu and Kashmir. These areas have an annual rainfall of over 100 cm. A variability of over 50 percent exists in the western part of Rajasthan, the northern part of Jammu and Kashmir, and the interior parts of the Deccan plateau. These areas have an annual rainfall of less than 50 cm. The rest of India has a variability of 25-50 percent and these areas receive an annual rainfall between 50 -100 cm. **Hence statement 2 is correct.**

Q 18.C

- Kaimur Hills, also called Kaimur Range, eastern portion of the Vindhya Range, starting near Katangi in the Jabalpur district of Madhya Pradesh and running generally east for a distance of about 300 miles (480 km) to Sasaram in Bihar. Its maximum width is about 50 miles.



- As seen from the given map below. The Kaimur Hills are at East of Bundelkhand, North of Baghelkhand, east of the Vidnyan range and west of the Hazaribagh plateau. Hence, option (c) is the correct answer.

Q 19.B

- All seawater contains large amounts of dissolved mineral matter of which sodium chloride or common salt alone constitutes more than 77 percent. Due to the free movement of ocean water, the proportions of different salts, remain remarkably constant in all oceans and even to great depths. However, the degree of concentration of the salt solution in oceans does vary appreciably in different areas.
- The average salinity of the oceans is 35.2 ppt, about 35 parts of salt in 1,000 parts of water. In the Baltic Sea, where there is much dilution by fresh water and melting ice, the salinity is much lower, only about 7 ppt. In the Red Sea where there is much surface evaporation and fewer rivers to bring in fresh water, the average salinity increases to 39 ppt.
- In enclosed seas, which are areas of inland drainages, such as the Caspian Sea, the salinity is very high, 180 ppt, and in the Dead Sea of Palestine a salinity of 250 ppt. has been recorded.
- The highest salinity is perhaps, that of Lake Van, in Turkey, with 330 ppt. It is a salt lake, and salts are collected from its shores. Hence, statement 2 is correct.**
- The density of the water is so high that in Lake Van or the Dead Sea, it is almost impossible to sink. Beginner swimmers will find it much easier to float here than anywhere else.**
- Salinity is lower than the average 35% in equatorial waters because of the heavy rainfall and high relative humidity. Hence, statement 1 is not correct.**
- The average salinity of the Indian Ocean is 35 ppt. The low salinity trend is observed in the Bay of Bengal due to the influx of river water. On the contrary, the Arabian Sea shows higher salinity due to high evaporation and low influx of fresh water.

Q 20.C

- Coasts of submergence, also known as drowned coasts, refer to coastal areas that have experienced a relative rise in sea level, causing the land to be partially or completely submerged by the sea.**
 - This phenomenon can be a result of various factors, including post-glacial rebound, tectonic subsidence, and the melting of polar ice caps. Coasts of submergence often exhibit distinct features and landforms. Here are some key characteristics and examples of submergent coasts.
- Ria Coasts:** Rias are submerged river valleys or estuaries that result from rising sea levels flooding the lower reaches of river valleys. They are characterized by a branching or dendritic pattern and often create deep, navigable waterways. An example is the Chesapeake Bay on the U.S. East Coast.
- Fjord Coasts:** Fjords are deep, narrow, and steep-sided coastal inlets that were originally glacial valleys. They are often surrounded by high cliffs or mountains. Norway's coastline is famous for its fjords, such as the Sognefjord.

- **Dalmatian Coasts:** Dalmatian coasts are characterized by a series of offshore islands running parallel to the mainland coast. They result from rising sea levels flooding previously existing river valleys or low-lying coastal areas. Croatia's Dalmatian Coast is an example.
- **Barrier Island Coasts:** Barrier islands are long, narrow, low-lying coastal landforms that run parallel to the mainland coast. They are separated from the mainland by tidal lagoons or estuaries. Barrier islands form as a result of rising sea levels and sediment deposition.
- **Estuarine Coasts:** Estuarine coasts feature extensive estuaries and tidal flats formed as rising sea levels inundate river valleys and coastal lowlands.
- **Hence option (c) is the correct answer.**

Q 21.C

River Cauvery

- It is known as 'Ponni' in Tamil and is one of the largest rivers in southern India.
- It is a sacred river of southern India. It rises on Brahmagiri Hill of the Western Ghats in southwestern Karnataka state, flows in a southeasterly direction, and descends the Eastern Ghats in a series of great falls and empties into the Bay of Bengal near Tiruchirapalli. Hence statement 1 is correct.
- The Cauvery basin is spread over 81,155 square kilometres (sq km) in the states of Karnataka (34,273 sq km), Tamil Nadu (43,856 sq km) and Kerala (2,866 sq km) and the Union Territory of Puducherry (160 sq km). Hence statement 2 is correct.
- It thrice forks into two streams and reunites a few miles farther on, thus forming the islands of Srirangappattanam, Sivasamudram, and Srirangam. Hence statement 3 is correct.



Q 22.B

- **Global Biofuels Alliance (GBA):**
 - On the sidelines of the annual G-20 summit in New Delhi, an India-led grouping came together to give impetus to the production and use of biofuels, an alternative to fossil fuels like petroleum and diesel.
 - The grouping, called the Global Biofuels Alliance (GBA) would attempt to bring countries together to co-develop, accelerate technological advances in production processes, and advocate for the use of biofuels particularly in the transport sector.
- **Members of Alliance:**
 - A total of 19 countries and 12 international organizations have so far agreed to join the alliance, including both G20 members and non-member countries. India, Brazil and the US are the founding members of the alliance. Hence option (b) is the correct answer.
 - Apart from India, Brazil and the US, the other G20 member countries supporting the initiative are Argentina, Canada, Italy, and South Africa. Bangladesh, Singapore, Mauritius, and the UAE are the G20 invitee countries.

- The non-G20 interested in joining the alliance are Iceland, Kenya, Guyana, Paraguay, Seychelles, Sri Lanka, and Uganda and Finland.
- Further, World Bank, Asian Development Bank, World Economic Forum, World LPG Organization, UN Energy for All, UNIDO, Biofutures Platform, International Civil Aviation Organization, International Energy Agency, International Energy Forum, International Renewable Energy Agency, World Biogas Association are the interested international and multilateral organizations.
- The three founding members of alliance, the US, India and Brazil contribute about 85% of the global production and the 81% of consumption of ethanol.
- **China and oil producers like Saudi Arabia and Russia have however decided not to be part of the alliance.**

Q 23.A

- Lightning is mainly associated with convective clouds. Monsoon clouds are mainly stratiform. Therefore, lightning generally does not occur during the active phase of the monsoon season. However, the convective activity during the break spell of the monsoon may lead to the formation of convective clouds and hence the lightening.
- **Stratiform clouds have extensive horizontal development, as opposed to the more vertical development characteristic of convection. Stratiform clouds cover large areas but show relatively little vertical development. Hence, option (a) is the correct answer.**

Q 24.C

- **Alps** The Alps are a significant mountain range in Europe, stretching across several countries, including France, Switzerland, Italy, Austria, and others.
 - **They are primarily an example of fold mountains.** The formation of the Alps is associated with the collision of the African and Eurasian tectonic plates, resulting in the folding and uplift of rock layers.
- **Andes:** The Andes is the longest continental mountain range in the world, running along the western edge of South America, passing through countries like Peru, Chile, Ecuador, and others.
 - The Andes are primarily a result of the subduction of the Nazca Plate beneath the South American Plate.
 - While the Andes do involve volcanic activity due to this subduction, **they are considered to be an example of fold mountains because of the extensive folding and uplifting of rock layers caused by the plate tectonics.**
- **The Sierra Nevada** is a mountain range located in the western United States, primarily in California and Nevada.
 - **The Sierra Nevada is not classified as fold mountains. Instead, it is an example of fault-block mountains. The range was formed by the movement along fault lines, resulting in blocks of the Earth's crust being uplifted and tilted.**
- **The Appalachian Mountains, often referred to as the Appalachians, are indeed old fold mountains.** They are one of the oldest mountain ranges in the world and are located in eastern North America, stretching from the Canadian province of Newfoundland and Labrador in the north to the U.S. state of Alabama in the south.
- **Important Mountain Ranges of the World**
 - Andes: Pass through several South American countries, including Peru, Bolivia, Chile, Ecuador, and Colombia.
 - Rocky Mountains: Pass through the United States and Canada.
 - Ural Mountains: Pass through Russia and Kazakhstan.
 - Atlas Mountains: Located in North Africa, passing through Morocco, Algeria, and Tunisia.
 - Caucasus Mountains: Pass through Russia, Georgia, Armenia, and Azerbaijan.
 - Great Dividing Range -Australia
- **Hence option (c) is the correct answer.**

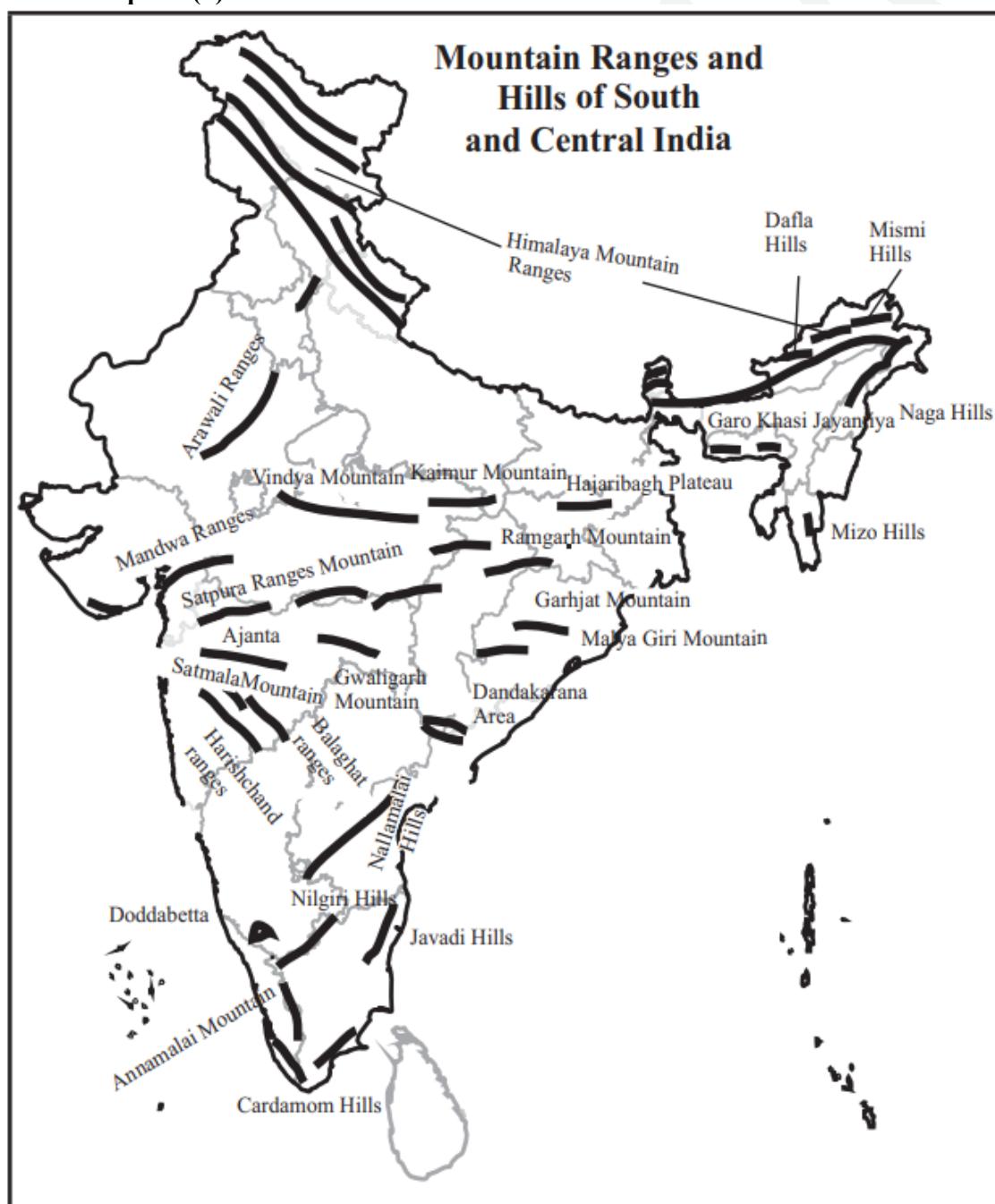
Q 25.C

- **Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES):**
 - IPBES is an **independent intergovernmental body** established to strengthen the science-policy interface for biodiversity and ecosystem services, working in a similar way to the IPCC, which is the UN's climate science body. **Hence statement 1 is not correct.**
 - Background: In June 2010, the **Busan outcome document adopted by member states of UN established the' Intergovernmental Platform on Biodiversity and Ecosystem Services'. Hence statement 2 is correct.**

- ✓ All States Members of the United Nations are eligible for IPBES membership. Hence statement 3 is correct.
- ✓ India is a member state of Intergovernmental Platform on Biodiversity and Ecosystem Services (joined in 2012).
- ✓ Its seat of the secretariat located in Bonn, Germany
- In the most extensive study on invasive species carried out to date, the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) in its new publication – the “**Assessment Report on Invasive Alien Species and their Control**” – has found that there are 37,000 alien species, including plants and animals, that have been introduced by many human activities to regions and biomes around the world, including more than 3,500 invasive alien species and that invasive alien species have played a key role in 60% of global plant and animal extinctions recorded.
 - The report, says that invasive alien species are **one of the five major direct drivers of biodiversity loss globally**, alongside land and sea use change, direct exploitation of organisms, climate change, and pollution.

Q 26.D

- The correct locational sequence from north to south of the given hills is - Pir Panjal Range (Jammu and Kashmir to Himachal Pradesh) followed by Kaimur Hills followed by Satmala Hills (Maharashtra).
- **Hence option (d) is the correct answer.**



Q 27.A

- The trade winds are those blowing from the sub-tropical high-pressure areas towards the equatorial low-pressure belt. Therefore, these are confined to a region between 30° N and 30° S throughout the earth's surface. **They flow as the north-eastern trades in the northern hemisphere and the south-eastern trades in the southern hemisphere.** Hence statement 1 is not correct.
- **Trade winds are descending and stable in areas of their origin (sub-tropical high-pressure belt), and as they reach the equator, they become humid and warmer after picking up moisture on their way.** The trade winds from two hemispheres meet near the equator, and due to convergence, they rise and cause heavy rainfall. Hence statement 2 is not correct.
- Trade winds are generally very predictable. They have been instrumental in the history of exploration, communication, and trade. Ships relied on trade winds to establish quick, reliable routes across the vast Atlantic and, later, Pacific Oceans. Even today, shipping depends on trade winds and the ocean currents they drive.
- Trade winds that form over land (called continental trade winds) are warmer and drier than those that form over the ocean (maritime trade winds). The relationship between continental and maritime trade winds can be violent.
- Most tropical storms, including hurricanes, cyclones, and typhoons, develop as trade winds. Differences in air pressure over the ocean cause these storms to develop. As the dense, moist winds of the storm encounter the drier winds of the coast, the storm can increase in intensity.
- **Strong trade winds are associated with a lack of precipitation, while weak trade winds carry rainfall far inland.** The most famous rain pattern in the world, **the Southeast Asian monsoon, is a seasonal, moisture-laden trade wind.** Hence statement 3 is not correct and statement 4 is correct.

Q 28.C

- Igneous rocks form when hot, molten rock crystallizes and solidifies. The melt originates deep within the Earth near active plate boundaries or hot spots, then rises toward the surface. Igneous rocks are divided into two groups, intrusive or extrusive, depending upon where the molten rock solidifies.
- **Intrusive Igneous Rocks:** Intrusive, or plutonic, igneous rock forms when magma is trapped deep inside the Earth.
- Extrusive, or volcanic, igneous rock is produced when magma exits and cools above (or very near) the Earth's surface.
- **The rate of cooling of the molten material, either magma or lava, is a primary factor that influences the texture of igneous rocks.**
 - Slower cooling allows mineral crystals to grow larger, resulting in a coarse-grained texture.
 - In contrast, rapid cooling leads to the formation of smaller mineral crystals and a fine-grained or even glassy texture in the resulting igneous rock.
- **Hence option (c) is the correct answer.**

Q 29.B

- **Storm Daniel:**
 - **Storm Daniel**, also known as Cyclone Daniel, was the deadliest and costliest Mediterranean tropical-like cyclone ever recorded in history.
 - Forming as a low-pressure system around 4 September 2023, the storm affected Greece, Bulgaria, and Turkey with extensive flooding. The storm then organized as a Mediterranean low and was designated as Storm Daniel.
 - **It soon acquired quasi-tropical characteristics and moved toward the coast of Libya, where it caused catastrophic flooding before degenerating into a remnant low.** Hence option (b) is the correct answer.
 - The storm was the **result of an omega block, as a high-pressure zone** became sandwiched between two zones of low pressure, with the isobars shaping like the Greek letter Ω .
 - In Greece, the storm was considered the worst in recorded history, with severe rainfall leading to flooding that caused more than two billion euros in damage.
 - **Libya was hit the hardest, with torrential rains causing** two dams near the city of Derna to fail.
- **Medicane**
 - Storm Daniel developed in Greece and was named by the Hellenic National Meteorological Service. As it moved towards Libya, Storm Daniel developed the characteristics of a Medicane - MEDiterranean hurriCANE.
 - This hybrid phenomenon shows some characteristics of a **tropical cyclone and others of a mid-latitude storm.** Such activity historically peaks between September and January.

Q 30.A

- As per the World Meteorological Organization (WMO) definition, the long-range forecast is defined as the forecast from 30 days up to one season's description of averaged weather parameters. The monthly and seasonal forecast comes under the long-range forecast. Hence, statement 2 is not correct.
- Long Period Average (LPA) of rainfall is the rainfall recorded over a particular region for a given interval (like month or season) average over a long period like 30 years, 50 years, etc. It acts as a benchmark while forecasting the quantitative rainfall for that region for a specific month or season. Hence, statement 1 is correct.
- The IMD predicts a “normal”, “below normal”, or “above normal” monsoon in relation to a benchmark “long period average” (LPA). It records rainfall data at more than 2,400 locations and 3,500 rain-gauge stations. Because annual rainfall can vary greatly not just from region to region and from month to month, but also from year to year within a particular region or month, an LPA is needed to smooth out trends so that a reasonably accurate prediction can be made.
- A 50-year LPA covers for large variations in either direction caused by freak years of unusually high or low rainfall (as a result of events such as El Nino or La Nina), as well as for the periodic drought years and the increasingly common extreme weather events caused by climate change.
- The IMD maintains five rainfall distribution categories on an all-India scale. These are:
 - Normal or near normal, when the percentage departure of actual rainfall is +/-10% of LPA, that is, between 96-104% of LPA;
 - Below normal, when the departure of actual rainfall is less than 10% of LPA, that is 90-96% of LPA;
 - Above normal, when actual rainfall is 104-110% of LPA;
 - Deficient, when the departure of actual rainfall is less than 90% of LPA; and
 - Excess, when the departure of actual rainfall is more than 110% of LPA.

Q 31.B

- A lunar eclipse is a celestial event that occurs when the Earth passes directly between the Sun and the Moon, causing the Earth's shadow to be cast on the Moon's surface. **This phenomenon can only happen during a full moon when the Earth, Moon, and Sun are closely aligned in space.**
- There are three main types of lunar eclipses:
 - **Penumbral Lunar Eclipse:** In a penumbral lunar eclipse, the Moon passes through the outer, lighter part of the Earth's shadow called the penumbra. This type of eclipse is subtle, and the darkening of the Moon's surface is often difficult to discern with the naked eye.
 - **Partial Lunar Eclipse:** During a partial lunar eclipse, a portion of the Moon passes through the darkest part of the Earth's shadow, known as the umbra. This results in a part of the Moon appearing darkened or shadowed, while the rest remains in full view.
 - **Total Lunar Eclipse:** A total lunar eclipse occurs when the entire Moon passes through the Earth's umbra. During this type of eclipse, the Moon can take on a reddish or copper hue due to the scattering of sunlight by the Earth's atmosphere. This reddish appearance is often referred to as a "Blood Moon." Hence pair 2 is correctly matched.
- Lunar eclipses are safe to observe with the naked eye, unlike solar eclipses, which require protective eyewear.
- **Total lunar eclipses are less common than partial and penumbral eclipses. The frequency of total lunar eclipses can vary from year to year. It's possible to have multiple total lunar eclipses in a single year, but it's also possible to have years with no total lunar eclipses.**
- **A monthly Blue Moon refers to the second full moon within a single calendar month. Hence pair 3 is correctly matched.**
- **A supermoon is a full moon or a new moon that nearly coincides with perigee—the closest that the Moon comes to the Earth in its elliptic orbit—resulting in a slightly larger-than-usual apparent size of the Moon as viewed from Earth. Hence pair 1 is not correctly matched.**

Q 32.D

- The Penganga River originates from the Buldhana range of Maharashtra. It joins Wardha and the combined stream of them and Wainganga meets the Pranhita river. Pranhita finally joins the Godavari river. Thus, **Penganga is a tributary of Godavari. Hence pair 1 is correctly matched.**
- **The Mahanadi is one of the major east-flowing peninsular rivers in India, originating in the Dhamtari district of Chhattisgarh and draining into the Bay of Bengal. The Seonath is the longest tributary of Mahanadi which rises in the midst of numerous small groups of hills in Rajnandgaon district of Chhattisgarh. Hence pair 2 is correctly matched.**

- Barakar River originates from a place called Padma situated in the district of Hazaribagh in the state of Jharkhand. Barakar River runs down from west to east direction diagonally to the northernmost part of the Chota Nagpur table pours across 225 kilometers of the area and later merges into Damodar situated near Dishergarh of the district of Bardhaman in West Bengal. Hence pair 3 is correctly matched.
- A major tributary of the Cauvery River is the Bhavani River. The river is two hundred and seventeen kilometers long and flows through the states of Kerala and Tamil Nadu. Hence pair 4 is correctly matched.

Q 33.A

- **Gujarat Declaration:**
 - The World Health Organisation (WHO) has unveiled the "**Gujarat Declaration,**" the outcome document of the first WHO Traditional Medicine Global Summit 2023. This historic summit, which took place in Gandhinagar marked a significant step in reaffirming global commitments towards indigenous knowledge, biodiversity, and traditional, complementary, and integrative medicine (TCIM). Hence option (a) is the correct answer.
 - The Gujarat Declaration places India in a pivotal role, emphasizing its importance in scaling up WHO's capacities to support member states and stakeholders in advancing the summit's action agenda and other relevant priorities.

Q 34.C

- The atmosphere consists of different layers with varying density and temperature. Density is highest near the surface of the earth and decreases with increasing altitude. The column of the atmosphere is divided into five different layers depending upon the temperature condition. They are the troposphere, stratosphere, mesosphere, thermosphere and exosphere.
- The troposphere is the lowermost layer of the atmosphere. Its average height is 13 km and extends roughly to a height of 8 km near the poles and about 18 km at the equator. The thickness of the troposphere is greatest at the equator because heat is transported to great heights by strong convectional currents.
- This layer contains dust particles and water vapour. All changes in climate and weather take place in this layer. **Hence statement 2 is correct.**
- **The temperature in this layer decreases at the rate of 1°C for every 165m of height.** This is the most important layer for all biological activity.
 - The Lapse Rate is the rate at which temperature changes with height in the Atmosphere. Lapse rate nomenclature is inversely related to the change itself: if the lapse rate is positive, the temperature decreases with height; conversely if negative, the temperature increases with height. **Hence statement 1 is correct.**
- The zone separating the troposphere from the stratosphere is known as the tropopause. The air temperature at the tropopause is about minus 80 degrees C over the equator and about minus 45 degrees C over the poles. **The temperature here is nearly constant**, and hence, it is called the tropopause. **Hence statement 3 is correct.**

Q 35.A

- Moons – also called natural satellites – come in many shapes, sizes and types. They are generally solid bodies, and few have atmospheres. Most planetary moons probably formed out the discs of gas and dust circulating around planets in the early solar system.
- The "traditional" moon count most people are familiar with stands at 290: One moon for Earth; two for Mars; 95 at Jupiter; 146 at Saturn; 27 at Uranus; 14 at Neptune; and five for dwarf planet Pluto.
- Important satellites of the planets in our solar system are
 - Mercury: No known natural satellites.
 - Venus: No known natural satellites.
 - Earth: One natural satellite - the Moon.
 - **Mars:** Two small moons - **Phobos** and Deimos.
 - **Jupiter:** Jupiter has many moons, including **Ganymede**, Callisto, Io, and Europa, among others.
 - **Saturn:** Saturn has numerous moons, with some of the largest being **Titan**, Rhea, and Enceladus.
 - **Uranus:** Uranus has several moons, including Titania and Oberon.
 - **Neptune:** Neptune has several moons, with Triton being the largest.
- **Jupiter's icy moon Ganymede is the largest moon in our solar system, even bigger than the planet Mercury, and the dwarf planet Pluto.**
- **Hence option (a) is the correct answer.**

Q 36.D

- The 7,938-acre shola forest that is part of the Western Ghats, recognised as one of the biological hotspots in the world and notified as an ecologically sensitive area by the Ministry of Environment and Forests, has now become a bone of contention between the Forest Department and the Revenue Department. The 7,938-acre shola forest that is part of the Western Ghats, recognised as one of the biological hotspots in the world and notified as an ecologically sensitive area by the Ministry of Environment and Forests, has now become a bone of contention between the Forest Department that claims the area to be a notified forest and the Revenue Department, that is accused of granting land for various activities over the years, insisting it is revenue land.
- **The Shola forests of South India derive their name from the Tamil word solai, which means a ‘tropical rain forest’.** Classified as ‘Southern Montane Wet Temperate Forest’ by experts Harry George Champion and SK Seth, the Sholas are found in the upper reaches of the Nilgiris, Anamalais, Palni hills, Kalakadu, Mundanthurai and Kanyakumari in the states of Tamil Nadu and Kerala.
- These forests are found sheltered in valleys with sufficient moisture and proper drainage, at an altitude of more than 1,500 metres. The upper reaches are covered with grasslands, known as Shola grasslands. The vegetation that grows in Shola forests is evergreen. The trees are stunted and have many branches. Their rounded and dense canopies appear in different colours.
- Generally, the leaves are small in size and leathery. Red-coloured young leaves turning into different colours on maturity is a prominent characteristic of the Shola forests. Epiphytes like lichens, ferns and bryophytes usually grow on the trees.
- **The occurrence of Himalayan plants like rhododendrons in these Shola forests is a mystery.** Paleobotanist Vishnu Mitter suggested that these are remnants of the vegetation driven to South India during the Quaternary Ice Age, about 2.6 million years ago, with subsequent changes in the tropics of South India.
- **Unfortunately, the Sholas have begun to gradually shrink due to the introduction of alien plant species and annual fire occurrences.** Pastoral communities, who settled in the grasslands centuries ago, periodically burn grass. This has checked the advance of the Shola forests. As tree species of the montane, evergreen forests are flammable, regeneration of any Shola tree species is completely prevented except for Rhododendron nilagiricum, the only Shola tree that can tolerate fire. Hence, option (d) is the correct answer.

Q 37.B

- On the basis of the prominent relief features, the Peninsular Plateau can be divided into three broad groups: The Deccan Plateau, the Central Highlands and the Northeastern Plateau.
- Central Highlands are bounded to the west by the Aravali range. The Satpura range is formed by a series of scarped plateaus on the south, generally at an elevation varying between 600-900 m above the mean sea level. This forms the northernmost boundary of the Deccan plateau. It is a classic example of the relict mountains which are highly denuded and form discontinuous ranges.
- **The extension of the Peninsular plateau can be seen as far as Jaisalmer in the West, where it has been covered by longitudinal sand ridges and crescent-shaped sand dunes called barchans.**
- This region has undergone metamorphic processes in its geological history, which can be corroborated by the presence of metamorphic rocks such as marble, slate, gneiss, etc. **The general elevation of the Central Highlands ranges between 700-1,000 m above the mean sea level and it slopes towards the north and northeastern directions.**
- **Most of the tributaries of the river Yamuna have their origin in the Vindhyan and Kaimur ranges.** Banas is the only significant tributary of the river Chambal that originates from the Aravalli in the west. **An eastern extension of the Central Highland is formed by the Rajmahal hills, to the south of which lies a large reserve of mineral resources in the Chotanagpur plateau.** Hence, option (b) is the correct answer.

Q 38.D

- Within the State of Manipur, there are two major river basins, viz. the **Barak River Basin and the Manipur River Basin. Hence, pair 2 is correctly matched.**
 - The total water resources of the two basins have been estimated to be 1.8487 million hectare meter in the form of annual yield. The Barak River originates from the northern hills and is joined by a number of tributaries such as Irang, Makru, Tuivai, etc., and thereafter enters the Cachar District of Assam. The Barak rises in the Manipur hills and enters the plains near Lakhipur. The river enters Bangladesh as Surma and Kushiyara. Later, the river is called the Meghna and receives the combined flow of the

Ganga and Brahmaputra. The principal tributaries of Barak are the Jiri, the Dhaleswari, the Singla, the Longai, the Sonai and the Katakhali.²

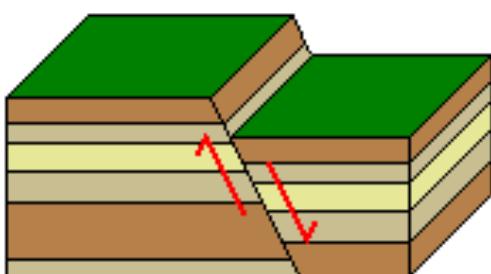
- **Meghalaya**, a state in northeast India, covers an area of approximately 22,430 square kilometers.
 - In the Garo hills, the important rivers of the northern system from west to east are the Kalu, Ringgi, Chagua, Ajagar, Didram, Krishnai, and Dudnai.
 - The important rivers of the southern system are Daring, Sanda, Bandra, Bhogai, Dareng and Simsang. Simsang is the largest river in the Garo hills.
 - In the central and eastern sections of the plateau, the important northward-flowing rivers are Umkhri, Digaru and Umiam and the south-flowing rivers are Kynchiang, Mawpa, Umiew, Myngot and Myntdu.
 - **The Myntdu River, Piyain River, and Someshwari River are transboundary rivers that flow into Bangladesh. Hence, pair 1 is correctly matched.**
- **Nagaland** is dissected by a number of seasonal and perennial rivers and rivulets.
 - The major rivers of Nagaland are Doyang, Dikhu, Dhansiri, Tizu, Tsurong, Nanung, Tsurang or Disai, Tsumok, Menung, Dzu, Langlong, Zunki, Likimro, Lanye, Dzuza and Manglu.
 - All these rivers are dendritic in nature. Of the rivers, Dhansiri, Doyang, and Dikhu flow westward into the Brahmaputra River that falls into Bangladesh.
 - **The Tizu River, on the other hand, flows towards the eastern part of Nagaland and joins the Chindwin River in Burma. Hence, pair 3 is correctly matched.**
- **The Khowati, the Manu, the Haorah, the Muhuri, and the Gomati are some important rivers of Tripura.**
 - **Gomati is the largest and is considered to be the most sacred of all the rivers in Tripura. Hence, pair 4 is correctly matched.**
 - The source of the river is taken to be Tirthamukh where lies the beautiful Dumbar Falls - one of the most important holy places. The rivers Khowai, Doloi, Manu, Juri, and Langai are flowing towards the north and those flowing towards the west are the Gomati, Muhuri and Feni.
 - **Not to be confused with Gomti River (Tributary of the Ganges):** The Gomti, Gumti, or Gomati River is a tributary of the Ganges which is different from the Gomati that flows in Tripura. After 190 kilometers (120 mi) the Gomti enters Lucknow, meandering through the city for about 30 kilometers (19 mi) and supplying its water. In the Lucknow area, 25 city drains pour untreated sewage into the river. At the downstream end, the Gomti barrage converts the river into a lake.
- **Most of the rivers of Mizoram originate in the Central part and flow either towards the south or north, creating deep gorges between the hill ranges.**
 - The main northerly flowing rivers of Mizoram are, Tlawng, Tut, Tian, Tuichawng, Tuirial, Tuivawl, Teirei, Tuirini and Serlui. The largest of these is the Tlawng (Dhaleshwari) with a length of 185.15 km. Tlawng, Tuirial and Tuivawl Rivers drain into the Barak River directly. All other rivers meet the Barak River through indirect and subsidiary channels either via Tripura-Bangladesh or via Manipur. Ultimately, the northerly flowing rivers of Mizoram, drain into the Barak River and constitute a part of the "Barak Basin". Barak River, in due course, drains into "Brahmaputra" as its left bank tributary. The southerly flowing rivers of Mizoram constitute part of the "Kolodoyne Basin". The southerly flowing rivers ultimately drain in the Bay of Bengal, either through Myanmar or through Bangladesh.

Q 39.B

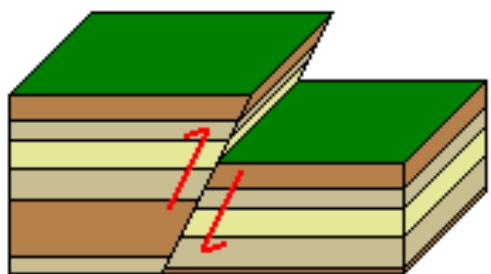
- **A fault is a fracture or discontinuity in the Earth's crust along which there has been movement of one or both sides relative to the other.**
 - Faults are fundamental geological features that play a crucial role in the Earth's tectonic processes and the deformation of the Earth's lithosphere
- **A reverse fault, also known as a thrust fault, is associated with compressional forces. In this type of fault, one block of rock is pushed up and over relative to the other.**
 - The hanging wall moves upward in relation to the footwall.
 - Reverse faults are common in regions where tectonic compression is occurring, such as convergent plate boundaries.
- A normal fault occurs in response to tensional forces, where one block of rock moves downward relative to the other. It is characterized by a hanging wall moving downward in relation to the footwall.
- A strike-slip fault results from horizontal shearing forces. In this type of fault, the movement is predominantly horizontal, with one block sliding past the other horizontally. The San Andreas Fault in California is a well-known example of a strike-slip fault.

- Transform Fault: A transform fault is a specific type of strike-slip fault that forms at the boundary between two tectonic plates. Here, the plates are sliding past each other horizontally. The famous boundary between the Pacific Plate and the North American Plate is an example of a transform fault.

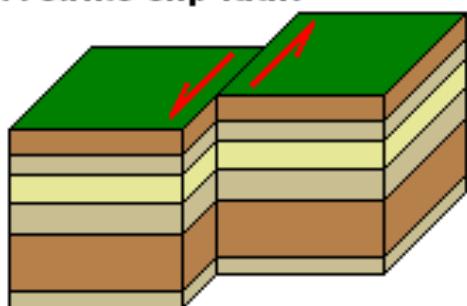
A normal fault



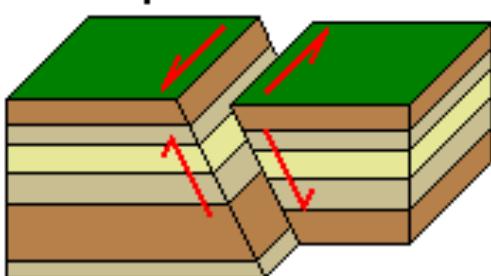
A reverse fault



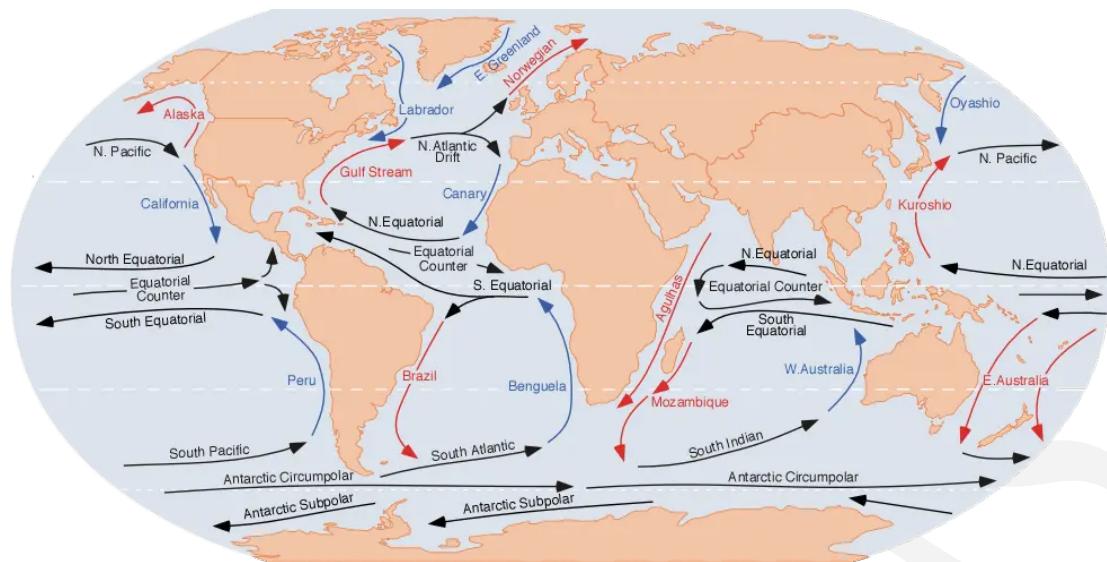
A strike-slip fault



An oblique fault



- Hence option (b) is the correct answer.



Ocean Current	Description
Gulf Stream	Warm ocean current originating in the Gulf of Mexico along the east coast of the United States
Labrador Current	Cold ocean current flowing from the Arctic Ocean south along the east coast of Canada
North Equatorial Current	East-to-west flowing current from 10°-20°N in the Pacific and the Atlantic Ocean
North Equatorial Counter Current (NECC)	West-to-east flowing current from 3°-10°N in the Atlantic, Indian Ocean, and the Pacific Ocean
South Equatorial Current	East-to-west current flowing between the equator and about 20°S in the Pacific, Atlantic, and Indian Ocean
South Equatorial Counter Current (SECC)	Weak east-flowing current near 8°S in the Atlantic and Pacific Ocean
Kuroshio Current	North-flowing warm current off the coast of Japan in the Pacific Ocean
Alaska Current	Southwestern warm water current off the coast of Alaska and west coast of Canada.
California Current	Southward flowing current off the west coast of the United States in the Pacific Ocean

- The Agulhas Current is found along the east coast of Africa and carries warm water from the tropics to higher latitudes. It is formed by the water movement in the western Indian Ocean, which is warmed by the sun and then flows southward along the east coast of Africa.
- Hence option (d) is the correct answer.

Q 41.C

- The Madhya Pradesh forest department has asked the Centre for an "alternate" site for cheetahs currently introduced at the Kuno National Park, which has seen the death of two felines in less than a month.
 - Other alternative sites for cheetah introductions are being prepared by the Government at **Gandhi Sagar Wildlife Sanctuary and also at Nauradehi Wildlife Sanctuary**.
 - Quarantine and acclimatization enclosures are under construction at Gandhi Sagar WLS and the site is expected to be ready by the year end. After evaluation of the site, the **next batch of cheetahs will be planned to be brought to Gandhi Sagar Wildlife Sanctuary**. Hence option (c) is the correct answer.
 - Conservation breeding of Cheetah Centre, Cheetah Research Centre, Interpretation Centre, Cheetah Management Training Centre and Cheetah Safari are being planned.
- **Gandhi Sagar Wildlife Sanctuary:**
 - **Location:**
 - ✓ It is situated on the northern boundary of the Mandsaur and Nimach districts in Madhya Pradesh. It lies in the Khathiar-Gir dry deciduous forest ecoregion. It was notified in the year 1974 and added to the list of sanctuaries in 1984. River Chambal flows through the sanctuary, dividing it into two parts.
 - **Topography:**
 - ✓ The sanctuary is characterised by its diverse topography, which includes hills, plateaus, and the catchment area of the Gandhi Sagar Dam on the Chambal River. The sanctuary has many places of historical, archaeological and religious importance, such as Chaurasigarh, Chaturbhujnath temple, Bhadkaji rock paintings, Narsinghjhar Hinglajgarh fort, Taxakeshwar temple etc.
 - **Flora:** The principal tree species found here are Khair, Salai, Kardhai, Dhawda, Tendu and Palash.
 - **Fauna:** Herbivores like Chinkara, Nilgai and Spotted Deer, and carnivores like the Indian Leopard, Striped Hyena and Jackal are found in good numbers in the region. It also has a good population of crocodiles, fish, otters and turtles.

Q 42.C

- Delta formation is a complex geological and geomorphological process that occurs at the mouths of rivers and is influenced by various environmental and geological conditions. The primary conditions favoring delta formation include:
 - **High Sediment Load:** Deltas typically form in areas where rivers carry a significant amount of sediment, such as sand, silt, and clay. High sediment loads are crucial because they provide the material needed to build up the delta over time.
 - Low Wave Energy: Deltas are more likely to form in regions with relatively calm and sheltered coastal conditions, where wave energy is minimal. High wave energy can disperse sediment before it has a chance to accumulate and form a delta.
 - ✓ Turbulent waves can disrupt the formation and maintenance of deltas by redistributing sediment.
 - **Shallow Coastal Waters:** Deltas tend to develop in shallow coastal areas or continental shelves. Shallow water allows sediment to settle out of the river's flow and accumulate on the seabed.
 - Minimal Tidal Influence: Strong tidal currents can disrupt the formation and maintenance of deltas by redistributing sediment. Therefore, areas with minimal tidal influence are more conducive to delta formation.
 - Stable Sea Level: Stable sea levels or slow rates of sea-level rise are important for delta formation. Rapid sea-level rise can submerge newly formed deltas, hindering their growth.
 - Sufficient Freshwater Flow: Deltas thrive on a consistent supply of freshwater from rivers. Seasonal variations in flow can influence delta growth, with higher flows typically leading to more rapid deposition.
 - **Multiple Distributaries:** Deltas often have multiple distributary channels through which river water and sediment can flow into the sea. These distributaries help distribute sediment across a wider area.
- Hence option (c) is the correct answer.

Q 43.A

- The International Date Line (IDL) is an imaginary line on Earth's surface defining the boundary between one day and the next.
- **The International Date Line (IDL) is located at about 180° east (or west). It is halfway around the world from the prime meridian (0° longitude), the reference point of time zones, which runs through Greenwich, UK.**
- **When you travel westward across the International Date Line (IDL), your calendar date typically advances by one day.** This means that if you were on a certain date, such as January 1st, and you cross the IDL traveling westward, you would generally skip a day and land on the following date, which would be January 2nd.
- Conversely, if you were traveling eastward across the IDL, you would typically subtract a day from your calendar date. For example, if you were on January 1st and crossed the IDL traveling eastward, you would generally end up on December 31st of the previous year.
- It's important to note that the IDL is not a straight line but rather follows the 180th meridian in the Pacific Ocean, and it has been adjusted in some places to accommodate local time zones and political boundaries.



- Hence option (a) is the correct answer.

Q 44.D

- **Indian Ocean Dipole (IOD)**, sometimes referred to as the Indian Nino, plays out in the relatively smaller area of the Indian Ocean between the Indonesian and Malaysian coastline in the east and the African coastline near Somalia in the west. One side of the ocean, along the equator, gets warmer than the other. IOD is said to be positive when the western side of the Indian Ocean, near the Somalia coast, becomes warmer than the eastern Indian Ocean. It is negative when the western Indian Ocean is cooler. Hence, statement 1 is correct.
- The air circulation in the Indian Ocean basin moves from west to east, that is from the African coast towards the Indonesian islands, near the surface, and in the opposite direction at the upper levels. That means the surface waters in the Indian Ocean get pushed from west to east. In a normal year, warmer waters in the western Pacific near Indonesia cross over into the Indian Ocean and make that part of the Indian Ocean slightly warmer. That causes the air to rise and helps the prevailing air circulation.
- In the years when the air circulation becomes stronger, warmer surface waters from the African coast are pushed towards the Indonesian islands, making that region warmer than usual. This caused more hot air to rise and the cycle reinforced itself. This is the state of negative IOD. The opposite case involves air circulation becoming slightly weaker than normal. In some rare cases, the air circulation even reverses direction. The consequence is that the African coast becomes warmer while the Indonesian coastline gets cooler.
- A positive IOD event is often seen developing at times of an El Nino, while a negative IOD is sometimes associated with La Nina. During El Nino, the Pacific side of Indonesia is cooler than normal because the Indian Ocean side also gets cooler. That helps the development of a positive IOD.
- **A positive IOD helps rainfall along the African coastline and also over the Indian sub-continent while suppressing rainfall over Indonesia, Southeast Asia, and Australia. The impacts are opposite during a negative IOD event because Negative IOD can lead to increased rainfall and atmospheric convection over the eastern Indian Ocean, Indonesia, and northern Australia. Hence, statement 2 is correct.**

Q 45.B

- **Vaalbara, Rodinia, and Pannotia are supercontinents in Earth's geological history.**
- **Vaalbara:** Vaalbara is believed to be one of the earliest supercontinents, existing around 3.6 to 2.7 billion years ago during the Archean Eon. It is a supercontinent that is thought to have been located near the South Pole. The evidence for Vaalbara comes from geological and paleomagnetic studies of rocks in parts of present-day Australia, India, and South Africa.
- **Rodinia:** Rodinia is another supercontinent that is thought to have existed around 1.3 billion to 750 million years ago during the Neoproterozoic Era. It was a vast landmass that assembled from smaller continental blocks and later broke apart. Rodinia's existence is supported by geological and paleomagnetic evidence, and it played a significant role in Earth's geological history.
- **Pannotia:** Pannotia is a supercontinent that is believed to have formed approximately 600 million years ago during the late Precambrian period. It is thought to have existed for a relatively short period before breaking apart. Pannotia is an important concept in understanding the geological events that occurred during the late Precambrian.
- **Hence option (b) is the correct answer.**

Q 46.D

- **Loin Loom Weaving:** It is also known as the backstrap loom. **Loin loom from Nagaland** is one of the oldest forms of weaving in the world. Weaving is the domain of women in Nagaland, and each tribe boasts of specific designs on their shawls, jackets, and sarongs. **Dramatic colour combinations, bold patterns, and striking minimalist geometric motifs mark loin loom weaving.** **Loin loom fabric has a special ribbed texture and is long-lasting.** **Most of the patterning in loin loom weaving is done in geometric designs, except for the warrior shawls of the Ao tribe,** which have hand-painted central band depicting tigers, bison, crossed spears, and roosters.
- **Mekhla Cheddar, Assam:** It is primarily crafted in Sualkuchi (Silk Village) of Assam, the weavers use **Muga Silk, one of the rarest silk in the world** to make the traditional garments of the State such as the Mekhela Chador. Similar to wine and cheese, this fabric is known for becoming more lustrous with time and is worn with pride by the Assamese community.
- **Tanchoi saris** are one of a kind, having spots all over the surface and woven with a dual color warp. The stand-alone feature of the Tanchoi sari is that the **fabric texture background has a satin finish. Extra threads are added to give these saris appearance of being embroidered.** Tanchoi Silk is said to have been brought to India by Chinese traders in the 19th century and later adapted to suit the preferences of Indian market. Three Parsi brothers are said to have traveled from India to China in the 19th century and were enamored by the technique. **After learning the skill, they came back to Surat, Gujarat and trained the weavers in the technique and then evolved the Tanchoi weaving technique into Indian versions.**
- **Moirang Phee** was initially woven in a historic village called Moirang, 46 km from Imphal. The **beautiful weave is said to have been woven by the villagers to gift the Meiti rulers, the royal family of Manipur.** The design of Moirang Phee is said to **represent the thin and pointed teeth of Pakhangba, the pythonic god of Manipur mythology.** The iconic motif is arranged in varying steps on the longitudinal border woven during the initial stage, has a sharp edge at the top and is woven sequentially so as to give an aesthetic look.
- **Hence, Option (d) is the correct answer.**

Q 47.B

- The air is set in motion due to the differences in atmospheric pressure. The air in motion is called wind. The wind blows from high pressure to low pressure. The wind at the surface experiences friction.
- In addition, rotation of the earth also affects the wind movement. The force exerted by the rotation of the earth is known as the Coriolis force. Thus, the horizontal winds near the earth surface respond to the combined effect of three forces - the pressure gradient force, the frictional force and the Coriolis force.
- **Pressure Gradient Force:** The differences in atmospheric pressure produces a force. The rate of change of pressure with respect to distance is the pressure gradient. The pressure gradient is strong where the isobars are close to each other and is weak where the isobars are apart.
- **Coriolis Force :**The rotation of the earth about its axis affects the direction of the wind. This force is called the Coriolis force after the French physicist who described it in 1844. It deflects the wind to the right direction in the northern hemisphere and to the left in the southern hemisphere.
 - The deflection is more when the wind velocity is high. The Coriolis force is directly proportional to the angle of latitude. It is maximum at the poles and is absent at the equator.

- **The Coriolis force acts perpendicular to the pressure gradient force.** The pressure gradient force is perpendicular to an isobar. The higher the pressure gradient force, the more is the velocity of the wind and the larger is the deflection in the direction of wind. **Hence statement 1 is not correct.**
 - As a result of these two forces operating perpendicular to each other, in the low-pressure areas the wind blows around it.
 - At the equator, the Coriolis force is zero and the wind blows perpendicular to the isobars. The low pressure gets filled instead of getting intensified. That is the reason why tropical cyclones are not formed near the equator.
- The velocity and direction of the wind are the net result of the wind generating forces. The winds in the upper atmosphere, 2 - 3 km above the surface, are free from frictional effect of the surface and are controlled mainly by the pressure gradient and the Coriolis force.
- **When isobars are straight and when there is no friction, the pressure gradient force is balanced by the Coriolis force and the resultant wind blows parallel to the isobar. This wind is known as the geostrophic wind. Hence statement 2 is correct.**
- The wind circulation around a low is called cyclonic circulation. Around a high it is called anti cyclonic circulation.

Q 48.B

- The fraction of light that is reflected by an object is called the albedo, which means *whiteness* in Latin. Black objects have an *albedo* close to 0, while white objects have an albedo of close to 1.0. The table below lists some representative albedos for Earth surface materials.
- Most of these albedos are sensitive to the angle at which the sunlight hits the surface; this is especially true for water. When the Sun is at angles of 40° and higher relative to the horizon, the albedo of the water is fairly constant, but as the angle decreases from 40°, the albedo increases dramatically, so that it is about 0.5 at a Sun angle of 10° and 1.0 at a sun angle of 0°. You are aware of this in the form of glare coming off the water in the early morning or in the evening before sunset.

Albedo of Earth Materials

Substance	Albedo (% reflectance)
Whole Planet	0.31
Cumulonimbus Clouds	0.9
Stratocumulus Clouds	0.6
Cirrus Clouds	0.5
Water	0.06 - 0.1
Ice & Snow	0.7 - 0.9
Sand	0.35
Grass lands	0.18 - 0.25
Deciduous forest	0.15 - 0.18
Coniferous forest	0.09 - 0.15
Rain forest	0.07 - 0.15

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

Q 49.D

- **Recent context:** At the recent **G-20 summit in Delhi**, Prime Minister Narendra Modi said it was the Global South's priorities that drove India's Presidency, and with developing countries Indonesia, India, Brazil and South Africa as consecutive hosts of the grouping, the direction seems set. Earlier this year, PM Modi hosted a virtual summit for the "**Voice of the Global South**", with about 125 countries included to seek their opinions on how to set those priorities.
- At last year's Climate change conference, CoP 27 in Egypt, the proclamation of the '**Loss and Damage fund**' was seen as a victory for the **Global South**, and in the upcoming CoP 28 in the UAE, the Global South will also drive conversations on mitigating climate change while keeping the development priorities of what was once called 'The Third World'.

- The term **Global South**, however, was an inaccurate representation of the countries it was meant to represent — many like India are more broadly in the Northern Hemisphere, while some like Australia in the Southern Hemisphere, are bracketed with the Global North.
- In the **1980s**, **economists developed the ‘Brandt Line’**, a curve that more accurately divided the world into the economic North and South. It encircles the world at a latitude of 30° N, passing between North and Central America, north of Africa, the Middle East and most of East Asia, but lowered towards the south to include Japan, Australia, and New Zealand above the line. Hence option (d) is the correct answer.

Q 50.C

- **The Savanna or Sudan Climate is a transitional type of climate found between the equatorial forests and the trade wind hot deserts.** It is confined within the tropics and is best developed in the Sudan where the dry and wet seasons are most distinct, hence its name Sudan Climate.
- In South America, there are two distinct regions of savanna north and south of the equator, namely the llanos of the Orinoco basin and the campos of the Brazilian Highlands. The Australian savanna is located south of the monsoon strip running from west to east north of the Tropic of Capricorn.
- **Climate of the Sudan Type:**
 - **Rainfall:** The Sudan type of climate is characterized by an alternate hot, rainy season and cool, dry season. In the northern hemisphere, the hot, rainy season normally begins in May and lasts until September, as in Kano, Nigeria. The rest of the year is cool and dry.
 - ✓ Both the length of the rainy season and the annual total rainfall decrease appreciably from the equatorial region polewards towards the desert fringes. On the whole, the annual precipitation is less than that of the Tropical Monsoon Climate and the length of the wet and dry seasons differs with the locality. In the southern hemisphere, the rainy season is from October to March (the southern summer). Its annual precipitation of 32 inches also varies much from year to year. Hence option (c) is the correct answer.
 - **Temperature:** The monthly temperature hovers between 79°F. and 90°F. for lowland stations. An annual temperature range of 20°F. is typical, but the range increases as one moves further away from the equator. It is, however, interesting to note that the highest temperatures do not coincide with the period of the highest sun (e.g. June in the northern hemisphere) but occur just before the onset of the rainy season. There is also a distinct drop in temperature in the rainy period, due to the overcast sky and the cooler atmosphere.
 - ✓ Days are hot, and during the hot season, noon temperatures of over 100°F. are quite frequent. When night falls the clear sky which promotes intense heating during the day also causes rapid radiation at night. Temperatures drop to well below 50°F. and night frosts are not uncommon at this time of the year. This extreme diurnal range of temperature is another characteristic feature of the Sudan type of climate.

Q 51.A

- Soil conservation and arresting degradation are some of the biggest challenges in front of the Indian agricultural sector. The loss of organic matter and essential nutrients is causing soil degradation at an alarming rate.
- A biogas plant produces clean and green energy through anaerobic digestion of agricultural/ municipal/ industrial waste, thereby reducing dependence on fossil fuels and reducing the stress on natural resources. Biogas can also be upgraded to produce Bio-CNG, which can be used as a transportation fuel.
- In terms of Soil conservation, the biogas industry has significant contributions to offer. **The biogas industry can play a significant role in stalling soil degradation by replenishing the organic material in the soil.** Apart from providing clean energy for agricultural and industrial purposes and reducing the dependence on fossil fuels, biogas can help return nutrients back to the soil and increase its fertility. The digestate from biogas plants helps combat desertification of soil by returning the organic component back to the soil. **An important nutrient, phosphorus is often the limiting nutrient in most soils. Phosphorus is constantly being lost from soils to the sea in the form of insoluble salts, which need to be replenished and can be recycled back into the soil using the digestate of biogas plants using agricultural residue as feedstock.** Hence, option (a) is the correct answer.

Q 52.C

- **Recent context: Chandrayaan-3's Vikram lander and Pragyan rover have made groundbreaking scientific discoveries** and performed breakthrough experiments in just a week of starting operations on the Moon.

- The Vikram lander is equipped with four payloads:
 - Chandra's Surface Thermophysical Experiment (ChaSTE),**
 - Instrument for Lunar Seismic Activity (ILSA),**
 - Radio Anatomy of Moon Bound Hypersensitive ionosphere and Atmosphere-Langmuir Probe (RAMBHA-LP),** and
 - Laser Retroreflector Array (LRA).** The LRA, developed by NASA, is the only Instrument onboard Chandrayaan-3 that is not indigenously developed.
- Vikram's ChaSTE payload** has generated the first temperature-depth profile of the lunar surface on the Moon's south pole.
- Pragyan's LIBS payload** has confirmed the presence of sulphur in the lunar surface region near the Moon's south pole. The instrument performed the first-ever in-situ measurements on the Moon's south pole.
- APXS is the second Pragyan rover payload** which has confirmed the presence of sulphur on the Moon's south pole. APXS also detected elements such as aluminium, silicon, calcium, and iron.
- RAMBHA-LP conducted experiments on the Moon's south pole** which revealed that **the plasma environment above the lunar south pole is sparse.**
- Hence option (c) is the correct answer.

Q 53.C

- A **major 7.8 magnitude earthquake** followed by another strong quake devastated wide swaths of Turkey and Syria killing thousands of people. The quake hit at depth of 18 kilometers and was **centered in southern Turkey**, near the northern border of Syria, according to the U.S. Geological Survey.
- In the first 11 hours, the region had felt **13 significant aftershocks** with a **magnitude of at least 5**, thus increasing the devastation.
- The quake occurred in a seismically active area known as the **East Anatolian fault zone**, which has produced damaging earthquakes even in the past. Almost all of Turkey is really seismically active.
- In this regard, some **general characteristics of an earthquake** include-
 - It is a **natural event** involving the **shaking of the earth** caused due to **release of energy**, which generates waves that travel in all directions.
 - The vibrations called **seismic waves** are generated from earthquakes that **travel through the Earth and are recorded on instruments called seismographs**. Yet, there are no such instruments yet that can predict an earthquake in advance. Hence, statement 3 is correct.
 - The **location below the earth's surface** where the earthquake starts is called **the hypocenter** and the **location directly above it on the surface of the earth** is called **the epicenter**. Hence, statement 1 is not correct.
 - The **causes** of earthquakes can be multiples including-
 - ✓ **Natural**
 - Due to **plate movement at transform boundary**
 - Due to **release of stress along a fault**
 - Due to plate movement at a **convergent boundary**, etc.
 - ✓ **Anthropogenic**
 - Dam-induced** e.g., the three georges dam
 - Dynamite-induced** e.g., during cutting of mountains, etc. Hence, statement 2 is not correct.

Q 54.B

- Normally, temperature decreases with an increase in elevation. It is called the normal lapse rate. At times, the situation is reversed and the normal lapse rate is inverted. It is called the inversion of temperature. Inversion is usually of short duration but quite common nonetheless.
- A long winter night with clear skies and still air is an ideal situation for inversion.** The heat of the day is radiated off during the night, and by early morning hours, the earth is cooler than the air above.
 - During the day, the sun heats the ground, which in turn heats the air in contact with it. This creates instability in the lower atmosphere, causing air to rise and mix with the surrounding air.
 - However, on long winter nights with clear skies and still air, the ground loses heat rapidly through radiation, cooling the air in contact with it. This cooler air is denser than the warmer air above it, creating a stable layer of air close to the ground.
 - As the night progresses, the ground continues to cool, and the stable layer of cool air near the ground becomes thicker. The cool air acts as a lid, trapping any warmer air above it, which prevents it from mixing with the cool air below.

- This creates a temperature inversion, where the temperature increases with height, and the coldest air is at the surface.
- The clear skies and still air are critical for the development and maintenance of a temperature inversion. Clear skies allow for the maximum amount of radiative cooling of the ground and the air near the surface.
- Still air prevents the mixing of warm and cool air, allowing the stable layer of cool air near the ground to become thicker and more pronounced. **Hence statement 1 is not correct.**
- Over polar areas, temperature inversion is normal throughout the year. Surface inversion promotes stability in the lower layers of the atmosphere. Smoke and dust particles get collected beneath the inversion layer and spread horizontally to fill the lower strata of the atmosphere.
- Dense fogs in the mornings are common occurrences, especially during the winter season. This inversion commonly lasts for a few hours until the sun comes up and begins to warm the earth.
- **The inversion takes place in hills and mountains due to air drainage.** Cold air in the hills and mountains, produced during the night, flows under the influence of gravity. Being heavy and dense, the cold air acts almost like water and moves down the slope to pile up deeply in pockets and valley bottoms with warm air above. **Hence statement 2 is correct.**
- This is called air drainage. It protects plants from frost damages

Q 55.A

- **The United Nations Convention against Transnational Organized Crime (UNTOC)** was adopted in 2000 to promote cooperation to prevent and combat transnational organized crime more effectively. The Convention came into force in September 2003. It is the **only global legally binding instrument against transnational organized crime** with 190 parties. **Hence statement 1 is correct.**
- As the guardian of the implementation of UNTOC, **UN Office on Drugs and Crime** has a vital role to play in assisting States in translating their commitments into actions. UNTOC has set up standards to assist parties in adopting legislation to establish criminal offences. It also establishes **frameworks for mutual legal assistance and extradition**, and foster law enforcement cooperation.
- The Convention is further supplemented by **three Protocols**, which target specific areas and manifestations of organized crime:
 - **The Protocol to Prevent, Suppress and Punish Trafficking in Persons, Especially Women and Children:** It is the first global legally binding instrument with an agreed definition on trafficking in persons.
 - **The Protocol against the Smuggling of Migrants by Land, Sea and Air:** It deals with the growing problem of organized criminal groups who smuggle migrants, often at high risk to the migrants and at great profit for the offenders.
 - **The Protocol against the Illicit Manufacturing of and Trafficking in Firearms, their Parts and Components and Ammunition:** Its objective is to promote, facilitate and strengthen cooperation among States Parties in order to prevent, combat and eradicate the illicit manufacturing of and trafficking in firearms, their parts and components and ammunition.
 - Countries must become parties to the Convention itself before they can become parties to any of the Protocols.
 - **The Protocol on Prohibitions or Restrictions on the use of Incendiary Weapons** is a United Nations treaty that restricts the use of incendiary weapons. It is a Protocol to the 1980 **Convention on Certain Conventional Weapons**. **Hence statement 2 is not correct.**
- **India has ratified** the United Nations Convention against Transnational Organised Crime in 2011. **Central Bureau of Investigation (CBI) is the national Nodal Authority** to receive and respond to all requests for all inter-state and cross-border assistance as a single point of contact and to act as liaison between the Ministry of External Affairs and other State parties on matters relating to the Convention as well as the Protocols. **Hence statement 3 is not correct.**

Q 56.C

- **One of the powerful opportunities to strengthen diplomatic ties amongst nations is exchanging gifts.** The G20 Summit at New Delhi proved to be an opportune platform for India to gift mementos bearing rich cultural heritage of the country to world leaders. The gifts shared to the foreign delegates included a curated compilation of handcrafted artifacts and products, which speak volumes about Bharat's rich cultural traditions.
- **The hamper comprised the following products: Sunderban Honey, Orange Pekoe tea from Darjeeling and Nilgiri tea, Coffee from Araku Valley, saffron from Kashmir valley, and different designs of stoles from different States to the G20 first Ladies.** Hence, statement 2 is correct.

- Darjeeling tea is the most valued tea in the world. Only tender shoots are handpicked from shrubs, located on the misty hills of West Bengal at altitudes of 3000-5000 ft. These nuances, along with the soil's unique character get reflected in the highly aromatic and invigorating cup that comes to your table.
- **The fact is Pekoe is a term commonly used among tea growers and tea traders to describe young leaf shoots bearing white down (fine hair).** As a producer, the experience that we have had is that the younger the pluck, the better the tea if all the other factors like weather and cultivar are kept constant.
- **Orange pekoe is the grade name for black tea. The concept of this grading system is largely based on leaf appearance. Hence, statement 1 is correct.**

Q 57.D

- The Cool Temperate Eastern Margin (Laurentian) Climate is an intermediate type of climate between the British and the Siberian type of climate.
- It has features of both the maritime and the continental climates. The Laurentian type of climate is found only in two regions. **Hence statement 2 is correct.**
 - North American region:
 - ✓ One is north-eastern North America, including eastern Canada, north-east U.S.A., (i.e. Maritime Provinces and the New England states), and Newfoundland.
 - Asiatic region:
 - ✓ Eastern coastlands of Asia, including eastern Siberia, North China, Manchuria, Korea and northern Japan.
- In the southern hemisphere, this climatic type is absent because only a small section of the southern continents extends south of the latitude of 40° S. **Hence statement 3 is correct.**
- **Climatic Conditions:**
 - **The Laurentian type of climate has cold, dry winters and warm, wet summers. Hence statement 1 is correct.**
 - Winter temperatures may be well below freezing point and snow falls to quite a depth. Summers are as warm as the tropics (21° - 27°C) and if it were not for the cooling effects of the off-shore cold currents from the Arctic, the summer might be even hotter.
 - Though rain falls throughout the year, there is a distinct summer maximum from the easterly winds from the oceans. Of the annual precipitation of 30 to 60 inches, two-thirds come in the summer. Winter is dry and cold because the winds are dry Westerlies that blowout from the continental interiors.

Q 58.D

- **Earth's magnetic field — also known as the geomagnetic field — is generated in our planet's interior and extends out into space, creating a region known as the magnetosphere.**
- Without the magnetic field, life on Earth as we know it would not be possible as it shields us all from the constant bombardment by charged particles emitted from the sun — the solar wind.
- **Earth has two sets of poles, geographic pole and magnetic poles. Earth's magnetic field can be visualized if you imagine a large bar magnet inside our planet, roughly aligned with Earth's axis.**
 - **Each end of the magnet lies relatively close (about 10 degrees) to the geographic North and South poles.** Earth's invisible magnetic field lines travel in a closed, continuous loop and are nearly vertical at each magnetic pole. **Hence statement 2 is not correct.**
- Geographic North and South poles are where lines of longitude converge. The Geographic North Pole is located in the middle of the Arctic Ocean and the Geographic South Pole is found in Antarctica.
- Magnetic poles are located where the magnetic lines of attraction enter Earth. The Magnetic North Pole is also known as the North Dip Pole and is currently found on Ellesmere Island in Northern Canada. When a magnetic compass points north it is aligning itself with Earth's magnetic field and points to the Magnetic North Pole, not the Geographic North Pole.
- **Earth's magnetic field is not fixed; it is dynamic and has undergone significant changes throughout geological history. This phenomenon is known as geomagnetic pole drift or magnetic field reversal.**
- **Geomagnetic Pole Drift:** The positions of Earth's magnetic north and south poles are not stationary. Instead, they slowly migrate and shift over time. This gradual movement of the magnetic poles is called geomagnetic pole drift. The poles can move several kilometers per year in different directions, primarily due to complex processes occurring in Earth's molten outer core.
- **Magnetic Field Reversals:** Geological records and studies of ancient rocks show that Earth's magnetic field has undergone reversals. In a magnetic field reversal, the magnetic north pole becomes the magnetic south pole, and vice versa. **Hence statement 1 is not correct.**

- These reversals are relatively infrequent, occurring on average every few hundred thousand years to a few million years. During these periods of reversal, Earth's magnetic field weakens and then re-establishes itself with reversed polarity.
- Geological Time: The shifts and reversals of Earth's magnetic field occur on geological time scales, which means they take place over tens of thousands to millions of years.
 - These changes are essential for understanding the history of our planet because they leave behind traces in rocks and minerals that record the magnetic orientation at the time of their formation.
 - Scientists use these records to study the history of Earth's magnetic field and the movement of the magnetic poles.
- **Hence option (d) is the correct answer.**

Q 59.A

- The moon's gravitational pull mostly and to a lesser extent the sun's gravitational pull, are the major causes for the occurrence of tides.
- Another factor is centrifugal force, which is the force that acts to counterbalance gravity.
- **Together, the gravitational pull and the centrifugal force are responsible for creating the two major tidal bulges on the Earth. Hence, statement 1 is correct.**
- On the side of the earth facing the moon, a tidal bulge occurs while on the opposite side through the gravitational attraction of the moon.
- The 'tide-generating' force is the difference between these two forces, i.e. the gravitational attraction of the moon and the centrifugal force.
- On the surface of the earth, nearest the moon, the pull or the attractive force of the moon is greater than the centrifugal force, and so there is a net force causing a bulge towards the moon.
- On the opposite side of the earth, the attractive force is less, as it is farther away from the moon, the centrifugal force is dominant. Hence, there is a net force away from the moon. It creates a second bulge away from the moon.
- **On the surface of the earth, the horizontal tide-generating forces are more important than the vertical forces in generating the tidal bulges.**
- **Spring tides:** The position of both the sun and the moon in relation to the earth has a direct bearing on tide height. When the sun, the moon, and the earth are in a straight line, the height of the tide will be higher. These are called spring tides and they occur twice a month, one on the full moon period and another during the new moon period.
- **Neap tides:** Normally, there is a seven-day interval between the spring tides and neap tides. Hence, statement 2 is not correct.
 - At this time the sun and moon are at right angles to each other and the forces of the sun and moon tend to counteract one another. The Moon's attraction, though more than twice as strong as the sun's, is diminished by the counteracting force of the sun's gravitational pull.

Q 60.D

- **Recent Context: Three years have been completed since the signing of the Abraham Accords.**
- **Abraham Accords** refers to the collective agreement between the United States (US), the United Arab Emirates (UAE) and Israel that was signed in September 2020.
 - According to the deal, the United Arab Emirates (UAE) will formally recognise the state of Israel, while the latter would halt its plans to annex parts of the occupied West Bank of Palestine. **Hence option (d) is the correct answer.**
 - These Accords were later extended to the countries of Sudan, Bahrain and Morocco.
 - The agreement marks the first normalization of ties between Israel and an Arab country since Jordan in 1994
 - ✓ Egypt was the first Arab State to sign a peace deal with Israel in 1979. Jordan signed a peace pact in 1994.
 - ✓ As per the agreement, the UAE and Bahrain will establish embassies, exchange ambassadors, cooperate and work together with Israel across a range of sectors, including tourism, trade, healthcare and security.
- **The Accords were called 'the Abraham Accords' as the three major monotheistic religions of the world, Islam, Christianity and Judaism, all find their roots in Prophet Abraham.**

Q 61.A

- The distinguishing characteristic of saline soils from the agricultural standpoint, is that they contain sufficient neutral soluble salts to adversely affect the growth of most crop plants. For purposes of definition, saline soils are those that have an electrical conductivity of the saturation soil extract of more than 4 dS/m at 25°C.
- In field conditions, saline soils can be recognized by the spotty growth of crops and often by the presence of white salt crusts on the surface. When the salt problem is only mild, growing plants often have a blue-green tinge. Barren spots and stunted plants may appear in cereal or forage crops growing on saline areas. The extent and frequency of bare spots is often an indication of the concentration of salts in the soil. If the salinity level is not sufficiently high to cause barren spots, the crop appearance may be irregular in vegetative vigor.
- **Excess soil salinity causes poor and spotty stands of crops, uneven and stunted growth, and poor yields, the extent depending on the degree of salinity. The primary effect of excess salinity is that it renders less water available to plants although some is still present in the root zone. This is because the osmotic pressure of the soil solution increases as the salt concentration increases. Apart from the osmotic effect of salts in the soil solution, excessive concentration and absorption of individual ions may prove toxic to the plants and/or may retard the absorption of other essential plant nutrients.**
- **Hence, option (c) is the correct answer.**

Q 62.C

- **The Massif Central is a prominent highland plateau region located in south-central France.** It is characterized by its plateaus, mountain ranges, and volcanic features. Geographically, it is part of the European continent and is one of the significant upland areas in Europe. **Hence pair 1 is correctly matched.**
- **The Loess Plateau is located in north-central China.** It spans several provinces, including Shaanxi, Shanxi, Henan, and Gansu. It covers an extensive area of approximately 640,000 square kilometers.
 - The defining feature of the Loess Plateau is the presence of vast deposits of loess, which are fine-grained, wind-blown sediments composed mainly of silt-sized particles. These deposits can be hundreds of meters thick and have a distinct yellow color, giving the plateau its name. **Hence pair 2 is correctly matched.**
- **Katanga Plateau is situated in the southeastern part of the Democratic Republic of the Congo (DRC).** It borders Zambia to the south and extends into neighboring provinces of the DRC. **Hence pair 3 is correctly matched.**
 - Katanga is renowned for its geological richness and is often referred to as the "Copperbelt" due to the extensive copper deposits found in the region. It also contains significant reserves of other minerals such as cobalt, uranium, and gold.
- **Major Plateaus of the World**
 - Tibetan Plateau
 - Columbia – Snake Plateau-USA
 - Colorado Plateau - USA
 - Kimberley Plateau - Australia
 - Mascarene Plateau - Indian Ocean
 - Laurentian Plateau - India
 - Patagonian Plateau - Argentina
 - Anatolian Plateau - Turkey
 - Ahaggar Plateau - Algeria
- **Hence option (c) is the correct answer.**

Q 63.C

- Extratropical cyclones, sometimes called mid-latitude cyclones or wave cyclones generally develop beyond the tropics and are associated with frontogenesis. The passage of the front causes abrupt changes in the weather conditions over the area in the middle and high latitudes.
- Extratropical cyclones form along the polar front. Initially, the front is stationary. In the northern hemisphere, warm air blows from the south, and cold air from the north of the front.
 - When the pressure drops along the front, the warm air moves northwards and the cold air moves towards, the south setting in motion an anticlockwise cyclonic circulation. The cyclonic circulation leads to a well-developed extratropical cyclone, with a warm front and a cold front.

- The processes of wind circulation both at the surface and aloft are closely interlinked. The extratropical cyclone differs from the tropical cyclone in a number of ways. The extra tropical cyclones have a clear frontal system which is not present in the tropical cyclones.
- The extratropical cyclones cover a larger area and can originate over the land and sea.** Whereas tropical cyclones originate only over the seas and on reaching the land they dissipate. **Hence statement 1 is not correct.**
- The extratropical cyclone affects a much larger area as compared to the tropical cyclone. **The wind velocity in a tropical cyclone is much higher and it is more destructive.** Hence statement 2 is correct.
- The extra tropical cyclones move from west to east but tropical cyclones, move from east to west.** Hence statement 3 is correct.

Q 64.D

- Electromagnetic Ion Cyclotron Waves:**
 - Scientists have identified Electromagnetic Ion Cyclotron (EMIC) waves, a form of plasma waves in the Indian Antarctic station, Maitri.
 - The EMIC waves are the discreet electromagnetic emissions observed in the Earth's magnetosphere. Their signatures can be recorded in both spaces as well as ground-based magnetometers. **Hence, statement 1 is correct.**
 - These waves are **generated in the equatorial latitudes** and propagate along magnetic field lines to their footprint in the high-latitude ionosphere. **Hence, statement 2 is correct.**
 - These waves **can resonate with charged particles**, particularly ions, that are trapped in the magnetosphere, **causing them to move in a cyclical motion.** Hence, statement 3 is correct.
 - These waves play an important role in the precipitation of **killer electrons** (electrons having speeds close to the speed of light, which form the radiation belt of planet Earth), which are hazardous to space-borne technology/instruments.
- Magnetosphere**
 - Magnetosphere is the cavity in which the Earth lies and stays protected from the wrath of the Sun.
 - It is formed by the interaction between Earth's magnetic field and the solar wind, which is a continuous stream of charged particles, mainly electrons and protons, flowing from the Sun.
 - Earth's magnetic field is generated by the motion of molten iron in its outer core.
- Magnetometer**
 - A magnetometer is a scientific instrument used to measure the strength and direction of magnetic fields.
 - It can be used to study the Earth's magnetic field, as well as the magnetic fields of other celestial bodies, such as planets, moons, stars, and galaxies.
 - Magnetometers work based on the principles of electromagnetic induction or magnetoresistance.

Q 65.C

- The aphelion position of the Earth is the point in its orbit around the Sun where it is farthest from the Sun. This occurs during the Earth's elliptical orbit when it is at its greatest distance from the Sun.**
- The Earth reaches its aphelion in early July, typically around July 4th each year. At this point, the Earth is about 152 million kilometers (about 94.5 million miles) away from the Sun.**
- In contrast, the perihelion position, when the Earth is closest to the Sun, occurs around early January, and at that time, the Earth is about 147 million kilometers (about 91.4 million miles) from the Sun.
- The variation in distance between aphelion and perihelion has a minor influence on the changing seasons but is not the primary driver of seasonal changes; the tilt of the Earth's axis plays a more significant role.
- Aphelion and perihelion exist due to the elliptical shape of Earth's orbit around the Sun. Earth's orbit is not a perfect circle; it is an ellipse, which is a slightly elongated, oval shape. This elliptical shape causes variations in Earth's distance from the Sun throughout the year.
- Hence both statements 1 and 2 are correct.**

Q 66.C

- The Global stocktake (GST):**
- The global stocktake (GST) aims to serve as a report card on the progress of countries under the 2015 Paris Agreement in achieving their climate action goals. While assessment reports by the Intergovernmental Panel on Climate Change (IPCC) put forth observations made by scientific experts, GST summarises 252 hours of conversations between governments, civil society organisations, experts and the UN bodies. The GST, therefore, combines scientific observations with on-ground experiences.

- The Conference of the Parties serving as the Meeting of the Parties to the Paris Agreement (CMA) under UNFCCC has the overall responsibility to conduct the global stocktake.
- Global stocktake synthesis report -UNFCCC
 - The first global stocktake technical synthesis report is released by the United Nations Framework Convention on Climate Change (UNFCCC). Hence option (c) is correct
 - The report warns that the world is “not on track” to meet the long-term goal of limiting global temperatures to 2 degrees Celsius.
 - The synthesis report ties into a larger exercise called the ‘global stocktake,’ that is expected to take place once in five years.
 - The report also acknowledged that improved Nationally Determined Contributions (NDC) from countries with ambitious emissions reduction targets have led to near-universal climate action. However, it is clear that the progress is inadequate and the window to “course correct” is rapidly closing.
 - The synthesis report culminates the second phase of the GST process, summarising three technical discussions held between 2022 and 2023. Its findings are expected to provide a strong science-based foundation for the third and final “politicalphase” of GST coming up at the 28th Conference of Parties (COP28) to the UNFCCC in Dubai later this year.

Q 67.B

- On Ganesh Chaturthi, as the business of the Parliament has been moved to the new building, the old Parliament House has officially been renamed as "Samvidhan Sadan". Hence statement 1 is not correct.
- It was the seat of:
 - The Imperial Legislative Council between 18 January 1927 and 15 August 1947,
 - The Constituent Assembly of India between 15 August 1947 and 26 January 1950, and
 - The Parliament of India between 26 January 1950 and 18 September 2023.
- The old Parliament House was designed by British architects Edwin Lutyens and Herbert Baker from 1912 to 1917. Hence statement 2 is correct.

Q 68.C

- World Soil Day (WSD) is held annually on 5 December as a means to focus attention on the importance of healthy soil and to advocate for the sustainable management of soil resources.
- An international day to celebrate soil was recommended by the International Union of Soil Sciences (IUSS) in 2002. Under the leadership of the Kingdom of Thailand and within the framework of the Global Soil Partnership, FAO has supported the formal establishment of WSD as a global awareness-raising platform. The FAO Conference unanimously endorsed World Soil Day in June 2013 and requested its official adoption at the 68th UN General Assembly.
- In December 2013, the UN General Assembly responded by designating 5 December 2014 as the first official World Soil Day. Hence, statement 1 is correct.
- World Soil Day 2022 (#WorldSoilDay) and its campaign "Soils: Where food begins" aims to raise awareness of the importance of maintaining healthy ecosystems and human well-being by addressing the growing challenges in soil management, increasing soil awareness and encouraging societies to improve soil health. Hence, statement 2 is correct.

Q 69.C

- The magnificent Nataraja sculpture that has been installed at Bharat Mandapam, venue of the G20 Leaders' Summit, portrays Lord Shiva in a form that was first seen in the fifth century AD, but which was made iconic under the Great Cholas.
- The Nataraja idol in Bharat Mandapam is an Ashtadhatu figure. It is known as the octo-alloy or a combination of eight metals in metallurgical terminology: gold, silver, copper, lead, zinc, tin, iron, and mercury.
- Srikanda Sthapathy, 61, who crafted the statue is from Swamimalai in Thanjavur district of Tamil Nadu. His design draws inspiration from three revered Nataraja idols — the Thillai Nataraja Temple in Chidambaram, the Uma Maheswarar Temple in Konerirajapuram, and the Brihadeeswara (Big) Temple, a UNESCO World Heritage Site, in Thanjavur. Hence statement 1 is correct.
- In a typical portrayal, Nataraja is encompassed by a flaming aureole or halo, which Sastri interpreted as “the circle of the world which he [Nataraja] both fills and oversteps”. The Lord’s long dreadlocks flare out due to the energy of his dance, and he strikes a rhythmic pose with his four arms.

- In his upper right hand He holds a damru (a hand drum), whose sounds “draw all creatures into his rhythmic motion”
- In his upper left arm, he holds agni (fire), which he can wield to destroy the universe.
- Beneath one of Nataraja’s feet lies crushed a dwarf-like figure, representing illusion, which leads mankind astray.
- Yet, amidst all the destructive symbolism, Nataraja also reassures, and shows Shiva as the Protector.
 - With his front right hand, he makes the ‘abhayamudra’ (a gesture that allays fear), and
 - With his raised feet, and with his front left arm he points to his raised feet, asking his devotees to seek refuge at his feet which symbolises salvation.
 - Strikingly, Nataraja almost always wears a broad smile.
- The 'Nataraja' statue has been made using an ancient casting technique called the lost-wax technique, which was used for making famed Chola bronze statues. In this metal casting process, molten metal, usually bronze, gold or silver, is poured into a mould made using wax or any resin-like material. Hence statement 2 is correct.
- All three temples that inspired the Bharat Mandapam Nataraja statue were originally constructed by the Cholas. Hence statement 3 is correct.
 - Thillai Nataraja Temple in Chidambaram.
 - Uma Maheswarar Temple in Konerirajapuram.
 - Brihadeeswara (Big) Temple in Thanjavur (a UNESCO World Heritage Site).

Q 70.C

- Each planet in our solar system rotates on its axis. So, each planet has a North and South Pole, the points where an axis meets the planet's surface. The time it takes for a planet or other celestial object to complete one spin around its axis is called its rotation period. Earth's rotation period is about 24 hours, or one day.
- Earth's axial tilt (also known as the obliquity of the ecliptic) is about 23.5 degrees. Due to this axial tilt, the sun shines on different latitudes at different angles throughout the year. This causes the seasons.
- **Changing seasons:** The Earth's axial tilt is the primary cause of changing seasons. As the Earth orbits the Sun, the axial tilt causes different parts of the planet to receive varying amounts of sunlight at different times of the year, leading to the seasonal changes we experience.
- **Variation in Daylight:** The axial tilt causes variations in the length of daylight hours throughout the year. During summer in the hemisphere tilted toward the Sun, days are longer, and nights are shorter. In contrast, during winter in the hemisphere tilted away from the Sun, days are shorter, and nights are longer.
- **Length of the year:** The length of the year is primarily determined by the time it takes for the Earth to complete one orbit around the Sun. The axial tilt, while influencing the seasons and weather patterns during this orbit, does not alter the overall duration of the year.
- **Solar Energy Distribution:** The tilt affects the angle at which sunlight strikes different parts of the Earth's surface. When sunlight hits at a more direct angle (as in summer), it provides more concentrated solar energy, leading to warmer temperatures. In contrast, when sunlight strikes at a more oblique angle (as in winter), it provides less concentrated solar energy, resulting in cooler temperatures.
- **Hence option (c) is the correct answer.**

Q 71.C

- After the complete loss of moisture, the air moving away from the equatorial low-pressure belt and the subtropical low-pressure belt in the upper troposphere is dry and cold. The blocking effect of air at upper levels because of the Coriolis force forces the cold, dry air to subside at 30° N and S. So, the high pressure (dynamically formed) along this belt is due to subsidence of air coming from the equatorial region and the subpolar region.
- **A calm condition (anticyclonic) with feeble winds is created in this high-pressure belt.** The subsiding air is warm and dry (heated due to an increase in ambient pressure), therefore, **most of the deserts are present along this belt**, in both hemispheres. Hence statements 1 and 2 are correct.
- The descending air currents in this belt feed the winds blowing towards adjoining low-pressure belts. This belt is frequently invaded by tropical and extra-tropical disturbances.
- **The corresponding latitudes of the subtropical high-pressure belt are called horse latitudes.** In the early days, sailing vessels with cargo of horses found it difficult to sail under the calm conditions of this high-pressure belt. They used to throw horses into the sea when fodder ran out. Hence the name horse latitudes. Hence statement 3 is correct.

Q 72.C

- The depressions which form in the monsoon season are called the monsoon depressions. These are low-pressure areas with two or three closed isobars which cause most of the monsoon rains. These can be of Bay origin, Land origin or Arabian Sea origin. Their shape is roughly elliptical and their horizontal extension is about 1000s of Kms of the surface. Its vertical extension is about 6-9 km.
- A monsoon depression is a cold core system over the surface and in the lower levels and a warm core in the upper levels. The monsoon depressions tilt southwards with height and if a monsoon depression is moving westward, the heavy rainfall is mainly concentrated in the SW quadrant.
- **Due to the high vertical wind shear present during the Southwest monsoon season, monsoon depressions generally do not intensify into cyclonic storms. Hence, option (c) is the correct answer.**

Q 73.C

- Various types of human activity decrease soil organic matter contents and biological activity. However, increasing the organic matter content of soils or even maintaining good levels requires a sustained effort that includes returning organic materials to soils and rotations with high-residue crops and deep- or dense-rooting crops. It is especially difficult to raise the organic matter content of soils that are well aerated, such as coarse sands, and soils in warm-hot and arid regions because the added materials decompose rapidly. Soil organic matter levels can be maintained with less organic residue in fine-textured soils in cold temperate and moist-wet regions with restricted aeration.
- The factors leading to a reduction in soil organic matter in an open cycle system can be grouped as factors that result in:
 - **a decrease in biomass production;**
 - ✓ **High harvest index.**
 - One of the consequences of the green revolution was the replacement of indigenous varieties of species with high-yielding varieties (HYVs). These HYVs often produce more grain and less straw, compared with locally developed varieties; **the harvest index of the crop (ratio of grain to total plant mass aboveground) is increased.** From a production point of view, this is a logical approach. However, this is less desirable from a conservation point of view. Reduced amounts of crop residues remain after harvest for soil cover and organic matter, or for grazing of livestock (which results in manure). Moreover, where animals graze the residues, even less remains for conservation purposes. **Hence, option 1 is not correct.**
 - **a decrease in organic matter supply;**
 - ✓ **Overgrazing**
 - There is a tendency throughout the world to overstock grazing land above its carrying capacity. Cows, draught animals and small ruminants graze on communal grazing areas and on roadsides, stream banks and other public land. Overgrazing destroys the most palatable and useful species in the plant mixture and reduces the density of the plant cover, thereby increasing the erosion hazard and reducing the nutritive value and the carrying capacity of the land. **Hence, option 2 is correct.**
 - **increased decomposition rates.**
 - ✓ **Tillage practices**
 - Tillage is one of the major practices that reduces the organic matter level in the soil. Each time the soil is tilled, it is aerated. As the decomposition of organic matter and the liberation of C are aerobic processes, the oxygen stimulates or speeds up the action of soil microbes, which feed on organic matter. **Hence option 3 is correct. This means that:**
 - When plowed, the residues are incorporated in the soil together with air and come into contact with many micro-organisms, which accelerates the carbon cycle. The decomposition is faster, resulting in the formation of less stable humus and an increased liberation of CO₂ to the atmosphere, and thus a reduction in organic matter.
 - The residues on the soil surface slow the carbon cycle because they are exposed to fewer micro-organisms and thus wane more slowly, resulting in the production of humus (which is more stable), and liberating less CO₂ to the atmosphere.

Q 74.D

- The Enhanced Collaborative Autonomous Rover System (ECARS), a cutting-edge 4×4 multi-terrain unmanned ground vehicle (UGV). The speed of the system ranges between 16 and 20 km per hour, with a payload capacity of 350 kg and towing payload capacity of 500 kg. **Hence, statement 1 is not correct.**

- ECARS UGV is armed with an enhanced collision avoidance system and advanced mission planning capabilities, rendering it a dependable resource for a wide range of military situations.
- **It is developed by Pune's Kalyani Strategic Systems Ltd, a fully-owned subsidiary of Bharat Forge. Hence, statement 2 is not correct.**
- **A key feature of ECARS is its compatibility with various systems, including Remote Controlled Weapon Stations (RCWS), water jet machines and capability of transporting heavy materials. This makes ECARS a key tool for border surveillance and more.**

Q 75.C

- Insolation is the amount of sun's energy received in the form of radiation by the earth. It is measured as the amount of solar energy received per square centimeter per minute.
- If the wavelength of the radiation is more than the radius of the obstructing particle (such as a gas), scattering of radiation takes place. **Most of the light received by Earth is scattered light.** If the wavelength is less than the obstructing particle (such as a dust particle), then reflection takes place.
- The solar radiation Earth receives primarily consists of shorter wavelengths of visible light. As Wein's law explains, **the sun's high temperature emits solar radiation of mostly shorter wavelengths. This incoming solar radiation may be scattered, reflected, or absorbed.**
- **Scattering** of solar radiation occurs when the radiation strikes very small objects in Earth's atmosphere, such as air molecules, tiny water droplets, ice crystals, or aerosols (tiny airborne particles), which disperse the solar radiation in all directions. Air molecules and aerosols scatter solar radiation in the atmosphere. Air molecules are much smaller than the wavelengths of visible light striking them. Therefore more of the blue, shorter wavelengths of light are scattered than the red, longer wavelengths of light. This is the reason why the sky appears blue during the daytime. Water droplets and ice crystals that make up clouds scatter light equally at all wavelengths and therefore appear white.
- **Hence both Statements 1 and 2 are correct.**

Q 76.A

- **Kufri: a small hill station in Shimla district of Himachal Pradesh. Located 20 km from the State capital Shimla, earlier known to be the summer retreat for the British, Kufri still harbors its past through the colonial buildings and architecture around. With its pleasant summer weather and winter snowfall, Kufri is flocked by tourists almost at all times. Hence pair 1 is not correctly matched.**
- **Chakrata: Nestled amidst lush conifers, flaming red rhododendrons, towering oaks, and the mighty snowy Himalayan ranges, Chakrata is one of Uttarakhand's veritable treasures and is situated about 88 km from Dehradun.** Chakrata is also home to several species of medicinal plants. Another popular tourist attraction of Chakrata is Tiger Falls. **Located about five km from the town, this waterfall drops from a height of over 300 m into a rocky pool. Owing to its high-security location, only Indian nationals can gain access to Chakrata.** Hence pair 2 is not correctly matched.
- **Kalimpong: Situated at an altitude of 1300 m on the eastern side of the Darjeeling Himalayas, Kalimpong district was formed on 14 February 2017 as the 21st district of West Bengal by splitting from Darjeeling district.** The allure of the mighty Himalayas, the pristine beauty of the Dooars, the dense virgin vegetation, the enchanting valleys and meadows and of course the perennially bright but cool weather have put Kalimpong district on the map of the most important tourist destinations in the Eastern Himalayas. **Hence pair 3 is correctly matched.**

Q 77.A

- **Mizoram is located in the northeastern part of the country and is bounded by Myanmar (Burma) to the east and south and Bangladesh to the west by the states of Tripura to the northwest, Assam to the north, and Manipur to the northeast. It does not open to the Bay of Bengal. Hence, statement 1 is not correct.**
- **Tripura shares borders with Bangladesh, Mizoram, and Assam.** Tripura is surrounded by Bangladesh on its north, south, and west. The length of its international border is 856 km (84 percent of its total border). The state is connected with the rest of India by NH-44 which runs through Assam, Meghalaya, North Bengal, Kolkata and other parts of India. **Hence, statement 2 is not correct.**
- **Assam shares an interstate boundary with West Bengal, Arunachal Pradesh, Meghalaya, Tripura, Nagaland, Manipur and Mizoram.** Its longest boundary is with Arunachal Pradesh and its shortest boundary is with Tripura. **It does not share a boundary with Sikkim. Hence, statement 3 is correct.**



Q 78.C

- A lake is an inland body of standing water that may be fresh, brackish, or saltish. Lakes are among the most widely distributed of all topographic features for they are found at all latitudes and altitudes in India.
- **Wular lake is the largest lake in the Kashmir valley**, which greatly influences the flow of the Jhelum and other rivers, **occupies a structural depression having occurred there**. Near Nainital, in the Kumaon Himalayas, there is a series of lakes that lie on a line formed by faulting. Hence, statements 1 and 3 are correct.
- As a result of the uneven deposition of sediment by the network of distributaries on a delta, some shallow basins are completely **surrounded by the deposits and converted into what is known as delta lakes**. Such lakes are also formed by the enclosing of a hollow between two deltas, as in the case of Kolleru Lake near Eluru in Andhra Pradesh due to the growth of the Godavari and Krishna deltas. Hence, statement 2 is correct.

Q 79.B

- **Hoodoos** are tall, thin rock spires or columns with a capstone that are often found in arid or semi-arid regions. They are created through the process of differential erosion, where varying rates of erosion affect different rock layers. Hence option 1 is correct.
 - Hoodoos typically form in sedimentary rock formations, especially those composed of sandstone or conglomerate rock.
 - The top of a hoodoo is often a flat, more erosion-resistant rock layer, known as the capstone, which protects the underlying layers from erosion.
- A hanging valley is a distinctive landform created by glacial erosion and is typically found in mountainous regions that have been shaped by past glaciation. Hence option 2 is correct.
 - A hanging valley is situated at a higher elevation relative to the main valley or glacial trough in which it is tributary.
 - Hanging valleys are formed as smaller glaciers, known as tributary glaciers, flow into and join a larger glacier, referred to as the trunk glacier.

- ✓ The trunk glacier, being more massive and powerful, erodes its valley deeper and wider compared to the smaller tributary glaciers.
- **Spits and bars are coastal landforms** created by the **deposition of sediments** by the action of waves, currents, and longshore drift. Hence option 3 is not correct.
 - **A spit is a long, narrow, finger-like landform that extends from the coastline into a body of water, typically the sea.**
 - ✓ Spits are formed by the gradual deposition of sediments, such as sand and gravel, carried by longshore drift—the movement of sediment along the shoreline due to the action of waves.
 - ✓ As waves approach the coast at an angle, they carry sediment with them. When the coastline changes direction or when there is a change in the wave dynamics, the sediment may be deposited, forming a spit.
 - **A bar is a submerged or partially submerged accumulation of sand, gravel, or sediment that forms beneath the water's surface, typically in coastal areas.**
 - ✓ Bars are often found offshore, parallel to the coastline, and can extend for varying distances.
 - ✓ They can form in various ways, such as when sediment carried by rivers or longshore drift is deposited at the point where a river meets the sea or when sediments accumulate where waves break offshore.

Q 80.C

- **ENSO is composed of both El Niño and Southern Oscillation.**
 - Thus, the oceanic component is called El Niño (or La Niña, depending on its phase) and the atmospheric component, is the Southern Oscillation.
 - Southern oscillation is an oscillation in air pressure between the tropical eastern and the western Pacific Ocean waters.
- **The strength of the Southern Oscillation is measured by the Southern Oscillation Index (SOI).** The SOI is computed from fluctuations in the surface air pressure difference between Tahiti (Over the Pacific Ocean) and Darwin, (Indian Ocean near Australia). El Niño episodes are associated with negative values of the SOI, meaning that the pressure at Tahiti is relatively low compared to Darwin. Hence, statements 1 and 2 are correct.
- Low atmospheric pressure tends to occur over warm water and high pressure occurs over cold water, in part because deep convection over the warm water acts to transport air. El Niño episodes are defined as sustained warming of the central and eastern tropical Pacific Ocean. This results in a decrease in the strength of the Pacific trade winds, and a reduction in rainfall over eastern and northern Australia.
- The **Walker circulation** is named after Sir Gilbert Walker, former Director General of Meteorology in India during British rule who, in the early 20th century, identified a number of relationships between seasonal climate variations in Asia and the Pacific region. He had shown that the weather in Djakarta (Indonesia) and Santiago (Chile) was related in such a way that when the pressure was higher than normal at one place it was lower than normal at the other. As these cities are about 15 000 km apart it was difficult at that time to visualize a mechanism for the connection between these distant locations.
- Later it is understood that what Walker had discovered was part of a teleconnection now known as the Southern Oscillation. The Southern Oscillation Index (SOI) gives a simple measure of the strength and phase of the Southern Oscillation and indicates the state of the Walker circulation. When the Walker circulation enters its El Niño phase, the SOI is strongly negative and when it enters its La Niña Phase, the SOI is strongly positive. Hence, statement 3 is correct.

Q 81.D

- Every September, the **International Rhino Foundation (IRF)** publishes its signature report, **State of the Rhino**, which documents current population estimates and trends, where available, as well as key challenges and conservation developments for the five surviving rhino species in Africa and Asia. Hence statement 1 is not correct.
- There are five species of rhino namely **Black rhino**, **Greater one-horned rhino**, **Javan rhino**, **Sumatran rhino** and **White rhino**. Out of them, three rhino species are found in Asia namely Sumatran rhino, Javan rhino and Greater one-horned rhino (Indian rhino).
- Three species of rhino—black, Javan, and Sumatran—are critically endangered.

- **Indian rhino is largest of all rhino species** and commonly found in India (Assam, West Bengal and Utter Pradesh), Nepal, Bhutan, and Pakistan. It is identified by a single black horn and a grey-brown hide with skin folds. It is **presently classified as 'vulnerable' on the International Union for Conservation of Nature (IUCN) Red List**. Hence statement 2 is not correct.

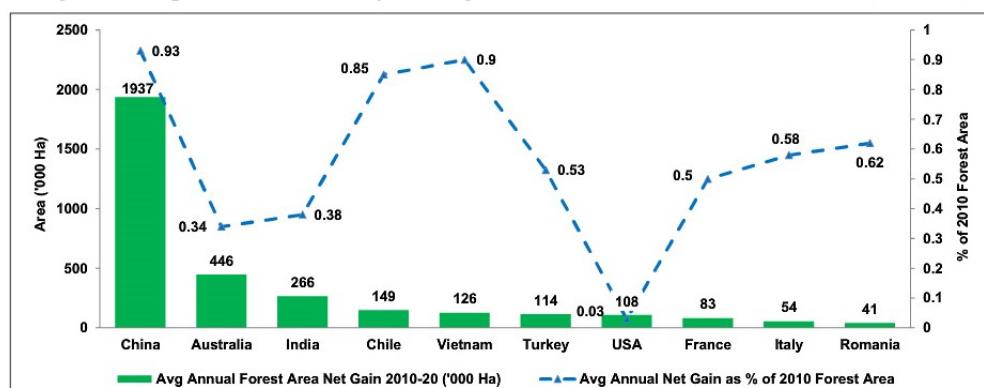
Q 82.A

- Recently Chhattisgarh State Wildlife Board rejected National Tiger Conservation Authority's (NTCA) recommendation to assign Bhoramdeo Wildlife Sanctuary (BWS) the status of a Tiger Reserve. Hence option (a) is the correct answer.
- Challenging the government's decision a public interest litigation (PIL), demanding to designate the Bhoramdeo Wildlife Sanctuary (BWS) as a tiger reserve and the Chilpi Range as a buffer zone has been filed. But the Chhattisgarh high court has dismissed a public interest litigation (PIL).
- The court emphasized that the National Tiger Conservation Authority (NTCA) had only suggested measures for the potential declaration of BWS as a Tiger Reserve and had not issued a binding recommendation.
- **There are to date 54 tiger Reserves and the last one to get the status was Guru Ghasidas National Park and Tamor Pingla Wildlife Sanctuary which is located in the state of Chhattisgarh.**

Q 83.D

- According to the Indian State of Forest Report 2021, the total forest and tree cover of the country is 80.9 million hectares which is 24.62 percent of the geographical area of the country. As compared to the assessment of 2019, there is an increase of 2,261 sq km in the total forest and tree cover of the country. Out of this, the increase in the forest cover has been observed as 1,540 sq km, and that in tree cover is 721 sq km.
- **Area-wise Madhya Pradesh has the largest forest cover** in the country followed by Arunachal Pradesh, Chhattisgarh, Odisha, and Maharashtra. In terms of forest cover as a percentage of total geographical area, the top five States are Mizoram (84.53%), Arunachal Pradesh (79.33%), Meghalaya (76.00%), Manipur (74.34%) and Nagaland (73.90%). Hence, statements 2 and 3 are not correct.

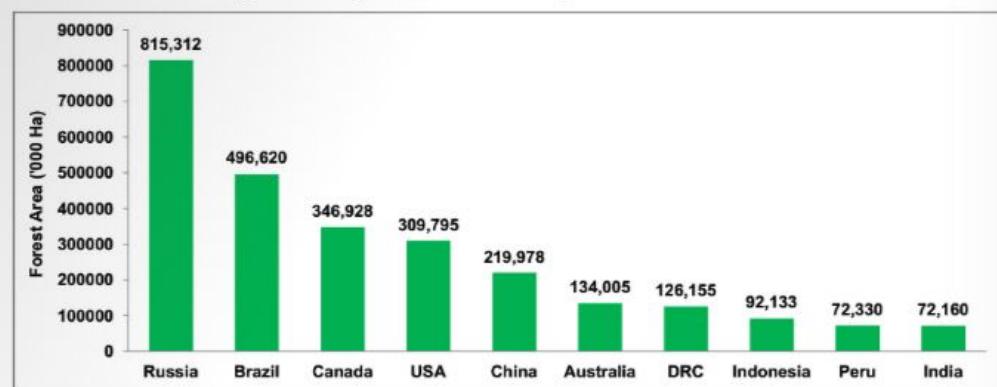
Figure 8: Top Ten Countries by Average Annual Net Gain in Forest Area (2010-20)



Source: India State of Forest Report 2021

- Also, **India ranks third globally with respect to the net gain in average annual forest area between 2010 and 2020**. India is the 10th largest in terms of total forest area. Hence, statement 1 is not correct.

Figure 6: Top Ten Countries by Forest Area in 2020



Source: India State of Forest Report 2021

Q 84.C

- **India becomes 13th country in world that can issue OIML certificates**
 - Domestic manufacturers of weighing and measuring equipment, like BP meters and cloth scales, can now get the instruments tested in India itself before selling them in the international market.
 - **An OIML Pattern Approval certificate is mandatory to sell a weight or measure in the international market, which the Department of Consumer Affairs can now issue. Hence statement 1 is correct.**
- **What is the OIML?**
 - The OIML stands for International Organisation of Legal Metrology. Established in 1955 and headquartered in Paris, the **OIML is an international standard-setting body. It develops model regulations, standards and related documents for use by legal metrology authorities and industry.**
 - **India became a member of the OIML in 1956.** In the same year, India signed the metric convention.
- **What is the OIML certificate?**
 - The OIML-CS is a system for issuing, registering and using OIML certificates, and their associated OIML type evaluation/test reports, **for instruments like digital balance, clinical thermometers, etc. With the addition of India, the number of countries authorised to issue OIML certificates has increased to 13.**
 - **When did India become a member of the OIML?**
 - ✓ **India became a member of the OIML in 1956. In the same year, India signed the metric convention. Hence statement 2 is correct.**
 - Twelve other countries, including Australia, Switzerland, China, the Czech Republic, Germany, Denmark, France and the United Kingdom, are authorised to issue these certificates.
- The move is expected to help the Indian economy in several ways, including an increase in exports, earning of foreign exchange, and generation of employment.

Q 85.A

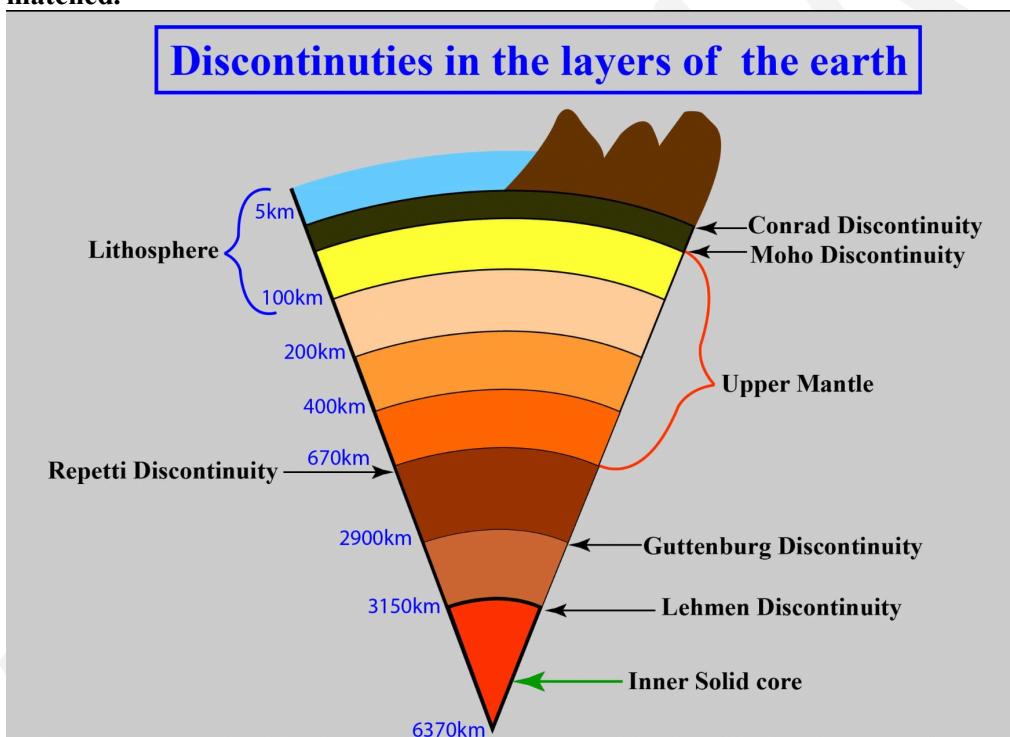
- Like land masses, ocean water varies in temperature from place to place both at the surface and at great depths. Unlike the solid earth, ocean water is mobile and variations in the temperature between different parts of the oceans can be expected.
- Water flowing out from the Arctic and Antarctic as cold currents, such as the Labrador Current off north-east Canada, lends to **reduce the surface-water temperature.** Ports of eastern Canada even at 45°N, are thus **icebound** for almost half the year.
- **In the same way, coasts warmed by warm currents, such as the North Atlantic Drift, have their surface temperature raised.**
- **Therefore, the Norwegian coast, even at latitudes 60° to 70°N. is ice-free throughout the year. Hence, statement II is correct and is the correct explanation of Statement I.**
- **The highest water temperatures are found in enclosed seas in the tropics**, e.g. the Red Sea which records a temperature of 85° to 100°F.
- **The Arctic and Antarctic waters are so cold that their surface is permanently frozen as pack ice down to a depth of several feet.** In the warmer summer, parts of the ice break off as icebergs that both dilute the water and lower the surface temperature of surrounding ice-free seas.
- The temperature of the oceans also varies vertically with increasing depth. It decreases rapidly for the first 200 fathoms, at the rate of 1°F. for every 10 fathoms, and then more slowly until a depth of 500 fathoms is reached. Beyond this, the drop is scarcely noticeable, less than 1°F. for every 100 fathoms. In the ocean deep below 2,000 fathoms (12,000 feet), the water is uniformly cold, just a little above freezing point.
- It is interesting to note that even in the deepest ocean trenches, more than 6 miles below the surface, the water never freezes. It is estimated that over 80 per cent of all ocean waters have a temperature between 35° and 40°F.

Q 86.A

- The Earth's interior is composed of several layers with distinct boundaries, known as discontinuities. These boundaries separate the Earth's interior into distinct zones characterized by variations in composition, density, and physical properties. Some of the major interior Earth discontinuities include:
- **The Mohorovičić Discontinuity**, often referred to as the "Moho," is one of the most important seismic boundaries within the Earth's interior. It is named after the Croatian seismologist Andrija Mohorovičić, who discovered it in 1909. **The Moho represents a significant boundary that separates the Earth's**

outermost layer, known as the crust, from the underlying mantle. Hence pair 1 is not correctly matched.

- The Moho is typically located at depths that vary depending on the geological setting and location. On average, it is situated around 5 to 10 kilometers (3 to 6 miles) below the Earth's surface beneath oceanic crust and approximately 20 to 70 kilometers (12 to 43 miles) below the Earth's surface beneath continental crust.
- **The Gutenberg Discontinuity**, also known as the "Gutenberg-Weber Discontinuity," is a significant seismic boundary or discontinuity within the Earth's interior. It is named after two German seismologists, Beno Gutenberg and Ernst Mohr Weber.
 - **The Gutenberg Discontinuity marks the boundary between two major portions of the Earth's mantle: the upper mantle and the lower mantle. These portions have distinct physical properties and behave differently in response to seismic waves. Hence pair 2 is not correctly matched.**
- **The Lehmann Discontinuity**, named after the Danish seismologist Inge Lehmann, is a seismic boundary or discontinuity within the Earth's interior. Inge Lehmann discovered this important boundary in 1936. The Lehmann Discontinuity is located deep within the Earth's core and marks a transition zone within this region.
 - **The Lehmann Discontinuity is found near the boundary between the Earth's outer core and its inner core. It marks the interface between these two core regions. Hence pair 3 is correctly matched.**



Q 87.B

- River capture, also known as stream piracy, is a geological phenomenon that occurs when one river or stream diverts the flow of another river, causing it to change its course and drainage pattern.
 - This process typically happens over a geological timescale and is driven by various factors, including differential erosion, changes in topography, and the relative discharge and erosional power of the rivers involved.
- River capture often occurs when one river has a higher discharge and erosional power than another. This can be due to differences in the type of bedrock, sediment load, or the gradient of the river.
 - The more erosive river can gradually wear away the landscape, creating a path through which it can divert the flow of the weaker river.
- Changes in the landscape, such as the uplift of mountains or the formation of geological faults, can alter the natural drainage patterns of rivers. These changes can create opportunities for one river to capture the flow of another.
- As erosion continues, the capturing river may develop a new channel that intersects with the course of the weaker river. When this happens, the capturing river begins to divert water and sediment from the weaker river.

- Over time, the captured river may erode its new channel more efficiently, causing the weaker river to lose water and eventually become a small tributary of the capturing river. This results in a change in the drainage pattern of the region.
- One famous example of river capture is the "Horseshoe Bend" on the Colorado River in the United States. The Colorado River captured the flow of a smaller tributary, gradually eroding through the landscape to create the horseshoe-shaped bend that we see today.
- Hence option (b) is the correct answer.**

Q 88.C

- Aditya-L1 is a satellite dedicated to the comprehensive study of the Sun. The Sun is a giant sphere of gas and Aditya-L1 would study the outer atmosphere of the Sun.
- It has 7 distinct payloads developed, all developed indigenously. Five by ISRO and two by Indian academic institutes in collaboration with ISRO.** There are seven payloads on-board, with four for remote sensing of the Sun and three for in-situ observation. **Hence, statement 3 is correct.**
- Aditya L1 shall be the first space based Indian mission to study the Sun.** The spacecraft shall be placed in a halo orbit around the Lagrange point 1 (L1) of the Sun-Earth system, which is about 1.5 million km from the Earth. **Hence, statement 2 is correct.**
- A satellite placed in the halo orbit around the L1 point has the major advantage of continuously viewing the Sun without any occultation/eclipses. This will provide a greater advantage of observing the solar activities and its effect on space weather in real time.
- A Lagrange point, as defined by NASA, is a position in space where “the gravitational pull of two large masses precisely equals the centripetal force required for a small object to move with them. These points in space can be used by spacecraft to reduce fuel consumption needed to remain in position.** Basically, this means that at that point, the gravitational attraction and repulsion between two heavenly bodies is such that an object placed between them will effectively stay in the same relative position while moving with them.
- The Lagrange points are named in honor of Italian-French mathematician Josephy-Louis Lagrange, and there are five of them: L1, L2, L3, L4, and L5. **According to NASA, “The L1 point of the Earth-Sun system affords an uninterrupted view of the Sun and is currently home to the Solar and Heliospheric Observatory Satellite SOHO.”** Hence, statement 1 is correct.

Q 89.B

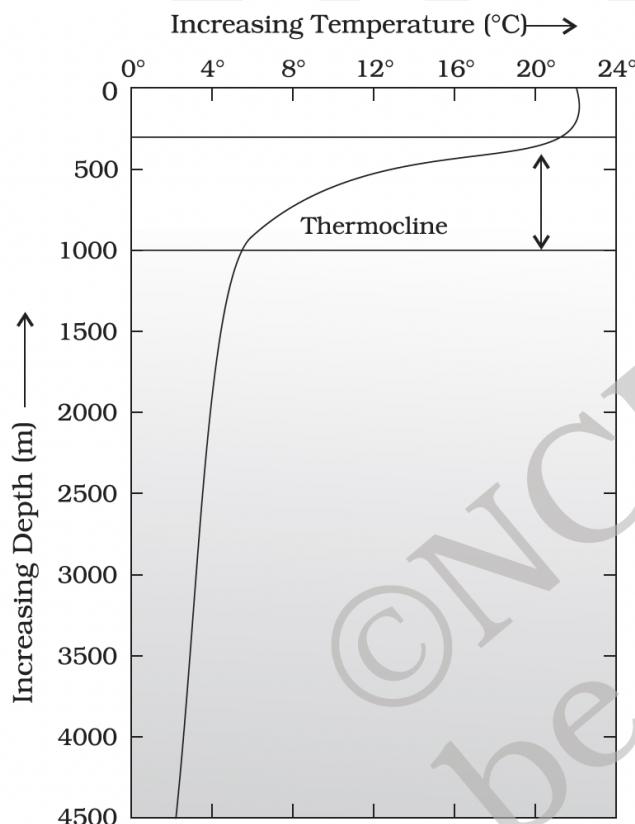
- The geological time scale is a system used by geologists and scientists to divide Earth's history into distinct intervals based on significant geological events, changes in life forms, and other important developments. It is divided into several hierarchical components,
- Eon: The largest division of geological time, typically spanning hundreds of millions to billions of years. There are two primary eons:**
 - Precambrian Eon: The longest eon, encompassing nearly 90% of Earth's history. It includes the Hadean, Archean, and Proterozoic eras.
 - Phanerozoic Eon: The eon during which complex life forms appeared. It includes the Paleozoic, Mesozoic, and Cenozoic eras.
- Era: The second-largest division, characterized by significant geological events and changes in life forms. The three eras within the Phanerozoic Eon are:**
 - Paleozoic Era: Known for the development of early marine life, the colonization of land by plants and animals, and the appearance of the first vertebrates and insects.
 - Mesozoic Era: Often referred to as the "Age of Dinosaurs," marked by the dominance of reptiles and the emergence of mammals and flowering plants.
 - Cenozoic Era: The current era, which began around 66 million years ago. It is known for the diversification of mammals, including the rise of primates and humans.
- Period: A subdivision of an era, characterized by distinctive rock layers and specific fossils. For example, the Mesozoic Era is divided into the Triassic, Jurassic, and Cretaceous periods.**
- Epoch: An even smaller division of time within a period. For instance, the Cenozoic Era includes the Paleogene and Neogene epochs.**
- Age (Chronozone):** The smallest and most detailed unit of the geological time scale, often defined by specific events or occurrences. Ages are named after characteristic rock formations or key fossils.
- Geologic Events:** Throughout the geological time scale, specific events like mass extinctions, glaciations, and major tectonic or volcanic events are used as reference points to mark significant changes in Earth's history.
- Hence option (b) is the correct answer.**

Q 90.A

- **The Scarborough Shoal** is one of Asia's most contested maritime features and a flashpoint for diplomatic flare-ups over sovereignty and fishing rights. It is an atoll administered by China and is **located in the South China Sea**. The atoll is a **disputed territory claimed by the Republic of the Philippines** through the 1734 Velarde map, while the **People's Republic of China** claim it through the disputed nine-dash line. It was in **news recently** as a fresh controversy broke out after **China installed a barricade near the South China Sea's Scarborough Shoal**. Hence pair 1 is correctly matched.
- **Izmail Sea Commercial Port**, is a multidisciplinary port located in the waters of the Kiliia River estuary of the Danube. It is located in Black Sea in **Ukraine**. It is an important transport hub of Ukraine. It was in **news recently** as **Russian drones damage the Izmail port infrastructure**. Hence pair 2 is not correctly matched.
- **Al Haouz** is a province in the Moroccan economic region of Marrakesh-Safi. In September of 2023, the province was the epicenter of a violent **magnitude 6.9 earthquake** which left over 2800 people dead. Hence pair 3 is not correctly matched.

Q 91.D

- The temperature-depth profile for the ocean water shows how the temperature decreases with increasing depth. The profile shows a boundary region between the surface waters of the ocean and the deeper layers.
 - The boundary usually begins around 100 - 400 m below the sea surface and extends several hundred of metres downward. **This boundary region, from where there is a rapid decrease in temperature, is called the thermocline**. About 90 percent of the total volume of water is found below the thermocline in the deep ocean. In this zone, temperatures approach 0° C. **Hence statement 1 is not correct.**
- The temperature structure of oceans over middle and low latitudes can be described as a three-layer system from the surface to the bottom. The first layer represents the top layer of warm oceanic water and it is about 500m thick with temperatures ranging between 20° and 25° C. This layer, within the tropical region, is present throughout the year but in mid-latitudes, it develops only during summer.
- **The thermocline is roughly 500 -1,000 m thick. Hence statement 2 is not correct.**
- The **third layer** is very cold and extends up to the deep ocean floor. In the Arctic and Antarctic circles, the surface water temperatures are close to 0° C so the temperature change with the depth is very slight. Here, only one layer of cold water exists, which extends from the surface to the deep ocean floor.
- The average temperature of surface water of the oceans is about 27°C and it gradually decreases from the equator towards the poles. The rate of decrease of temperature with increasing latitude is generally 0.5°C per latitude.



Q 92.B

- **Bhitarkanika Mangroves is India's second largest forest, located in Odisha.** Bhitarkanika is created by the two river delta of Brahmani and Baitarani rivers and one of the important Ramsar Wetlands in India. Hence, pair 3 is correctly matched.
- **Pichavaram mangrove is one of the largest mangroves in India, situated at Pichavaram near Chidambaram in Tamil Nadu.** Pichavaram ranks among the one of the most exquisite scenic spots in Tamil Nadu and is home of many species of Aquatic birds. Hence, pair 1 is not correctly matched.
- **Baratang Island Mangroves is a beautiful swamp, located at Great Andaman and Nicobar Islands.** Mangrove Swamps of Baratang Island are situated between Middle and South Andamans, the capital city of Port Blair. Hence, pair 2 is not correctly matched.
- **Ratnagiri Mangroves are located on the west coast of India in the state of Maharashtra.** The studies revealed that Ratnagiri district shows biodiversity of mangroves with 20 species with 15 genera. Hence, pair 4 is correctly matched.

Q 93.B

- **Seaweeds are a type of marine algae, often found in coastal waters. It can vary in size and colour and is used in various industries, including food, cosmetics, and agriculture.** Seaweed is rich in nutrients and has diverse applications worldwide.
- They are good source of calcium, magnesium, potassium, zinc, selenium, and a variety of other minerals and amino acids. They are the significant source of iodine, which aids thyroid function and combats infection. More than 95% of the seaweed harvested for human consumption is cultivated rather than taken from the wild. Hence, statement 1 is correct.
- **Unlike land-based crops, seaweed doesn't require fertilizer, pesticides, freshwater, or land.** It grows fast—some marine algae can be ready to harvest in as little as six weeks—and absorbs CO₂ while it's growing, making it a valuable carbon sink. Algae also absorbs other excess nutrients like nitrogen and phosphorus, and creates new habitats for marine life. Hence, statement 2 is correct.
- **Recently, the Ministry of Fisheries, Animal Husbandry & Dairying laid the Foundation Stone for a Multi-Purpose Seaweed Park in Tamil Nadu** (Valamavur, Ramanathapuram district). It is in line with the Union Budget 2021 that India's first Fisheries Aquapark in form of 'Multipurpose Seaweed Park in Tamil Nadu' will be established. Hence, statement 3 is not correct.
- The park aims to promote seaweed cultivation for employment, value-added products, and conservation. It involves 136 coastal fishing villages and offers support to entrepreneurs. The Multipurpose Seaweed Park is a significant investment to promote seaweed cultivation and research, benefiting scientists, researchers, and local communities.

Q 94.A

- The west coast of India has an orographic barrier in the form of the Western Ghats. These mountains are oriented in the north-south direction and are approximately 1000 km in length and 200 km in breadth.
- **When monsoon winds strike the mountains, on many occasions they do not have enough energy to climb over the Western Ghats. On such occasions, they tend to be deflected around the mountains and return current forms the off-shore vortex.**
- **These vortices are responsible for the occurrence of heavy to very heavy rainfall over the west coast during monsoon season.** Hence, both statements I and II are correct and statement II is the correct explanation for statement I.

Q 95.D

- Karst topography is a distinctive type of landscape characterized by unique landforms and geological features that result from the dissolution of soluble rocks, such as limestone, dolomite, and gypsum. These features are created through a combination of chemical weathering, underground water flow, and erosion. Here are some of the key features associated with karst topography :
 - **Sinkholes:** Sinkholes are depressions or holes in the ground that form when the bedrock beneath the surface is dissolved by groundwater, creating a void. They can vary in size from small pits to large, dramatic collapses. Sinkholes can pose hazards to construction and infrastructure.
 - **Caves:** Karst regions often contain extensive cave systems. These caves are formed when acidic groundwater dissolves the soluble rock along joints, fractures, and bedding planes, creating underground passages and chambers.
 - **Stalactites and Stalagmites:** Within karst caves, stalactites and stalagmites form as mineral deposits precipitate from water dripping or seeping into the cave. Stalactites hang from cave ceilings, while stalagmites grow upward from the cave floor. These formations can take on various shapes and sizes.

- **Poljes:** Poljes are large, flat, and elongated depressions or valleys that are often surrounded by mountains or hills. They form as a result of the coalescence of sinkholes and the subsidence of the land surface.
- **Dolines:** Dolines, also known as sinkhole basins or cenotes (in some regions), are bowl-shaped depressions that result from the collapse of cave roofs or the subsidence of surface layers.
- **Karst Towers or Cones:** These are tall, isolated limestone pillars or cone-shaped hills that are left standing as the surrounding rock erodes away.
- **Ponor or Swallow Hole:** These are points where surface streams disappear underground into a karst system through sinkholes or underground conduits.
- **Uvalas:** Uvalas are closed, oval-shaped depressions that resemble elongated sinkholes. They often result from the merging of multiple sinkholes in a karst landscape.
- Hence option (d) is the correct answer.

Q 96.C

- **Eparchaean Unconformity in Tirumala hills is one of the geo-heritage sites of India. It is the main discontinuity of the Eastern Ghats that occurred due to extensive erosion along the hill. Hence, option (c) is the correct answer.**
- Recently, a draft Geo-heritage Sites and Geo-relics (Preservation and Maintenance) Bill was brought in by the government in order to protect the geo-heritage sites. Among others, Eparchean Unconformity is a site to be protected.
- An unconformity is a break in time in an otherwise continuous rock record or it can be said to be a buried erosional or non-depositional surface separating two rock masses or strata of different ages, indicating that sediment deposition was not continuous.
- **About Archaean eon**
 - The Archean Eon, in older sources, sometimes called the Archaeozoic, is the second of the four geologic eons of Earth's history, preceded by the Hadean eon and followed by the Proterozoic. **The Archean represents the time period from 4,000 to 2,500 Ma.**

Q 97.C

- In the course of a year, the earth's revolution around the Sun with its axis inclined at 66.5 degrees to the plane of the ecliptic changes the apparent altitude of the midday Sun. The sun is vertically overhead at the equator only on two days each year. These are usually 21st March and 21st September. These two days are termed equinoxes. **Hence statement 1 is correct.**
- After the March equinox, the Sun appears to move north and is vertically overhead at the Tropic of Cancer on about 21st June. This is known as the June or Summer solstice when the northern hemisphere will have its longest day and shortest night. By about 22 December, the Sun will be overhead at the Tropic of Capricorn. This is the Winter solstice when the southern hemisphere will have its longest day and shortest night. **Hence statement 2 is not correct.**
- The tropics mark the limits of the overhead Sun, for beyond these, the Sun is never overhead at any time of the year. **Hence statement 3 is not correct.**

Q 98.D

- **Recent Context: Santiniketan (District Birbhum, West Bengal) has been designated as the 41st UNESCO World Heritage Site (WHS) of India.**
 - It is the third WHS of West Bengal, after the Sundarbans National Park and the Darjeeling Mountain Railways. **Hence statement 1 is not correct.**
- **Along with Rabindranath Tagore, Surendranath Kar, Nandalal Bose, Patrick and Arthur Geddes played key roles in shaping it.**
- Santiniketan is an ensemble of historic buildings, landscapes and gardens, pavilions, artworks, and continuing educational and cultural traditions.
 - It drew elements from ancient, medieval, and folk traditions of India as well as Japanese, Chinese, Persian, Balinese, Burmese and Art Deco forms (Western Europe and the United States).
 - **Indigenous Architecture Style:** It veered away from the prevalent Beaux Arts (Roman and Greek classicism but combined with more flamboyant French and Italian Renaissance) and European modernism. **Hence statement 2 is not correct.**
 - **Buildings Material:** Both traditional materials (mud and thatch) and reinforced cement concrete.
 - **Open spaces:** Integral part of complex, has been used for cultural exchange and safeguard Indian art and cultural events through the mediums of fairs and seasonal festivals

Key Architecture elements of different cultures

Culture	Examples
 Chinese	Circular window of Guhagar
 Japanese	woodwork
 Neo Gothic and Neo Classical	Bungalow style of Santiniketan Griha and Surul Kuthibari
 Buddhist	Ajanta (Patha Bhavan) and Sanchi (railing of Chhatim Tala)
 Sultanate and Mughal Period	Arches, facade, and jaalis
 Bengali	Chaiti, inspired by a rural Bengali hut

Q 99.D

- **Recent Context:** Recently many people were detained in Tripura during a 12-hour statewide strike called by the Twipra Students' Federation (TSF) to **press for the introduction of Roman script for Kokborok, state's indigenous lingua franca**, and other demands.
- **Kokborok is the language spoken by the Borok people belonging to Tripura.**
 - Borok is a branch of the Boro people of Assam belonging to the Sino-Tibetan linguistic group and racial Mongoloids.
 - Kokborok belongs to the Tibeto-Burman family and has a close affinity with other language families like Bodo, Garo, Dimasa etc.
 - ✓ **Doulot Ahammad wrote the first Kokborok Grammar (1897).**
- Hence option (d) is the correct answer.

Q 100.A

- **Recent Context:** The Government of India has come out with a new set of National Awards in the field of Science, Technology, and Innovation known as "Rashtriya Vigyan Puraskar".
- The Rashtriya Vigyan Puraskar shall be one of the highest recognitions in the field of science, technology, and innovation in India.
 - **Scientists/ technologists/innovators working in government, private sector organizations or any individual working outside any organization**, who have made distinguished contributions in terms of path-breaking research or innovation or discovery in any field of science, technology, or technology-led- led innovation shall be eligible for the awards.
 - **People of Indian Origin staying abroad with exceptional contributions benefiting the Indian communities or society shall also be eligible for the awards.**
- The awards shall be given in the following **four categories**:-
- **Vigyan Ratna (VR) award** will recognize **lifetime achievements & contributions** made in any field of science and technology. **Hence pair 1 is not correctly matched.**
- **Vigyan Shri (VS) award** will recognize **distinguished contributions** in any field of science and technology. **Hence pair 3 is not correctly matched.**
- **Vigyan Yuva-Shanti Swarup Bhatnagar (VY-SSB) award** will recognize & encourage young scientists up to the age of 45 years who made an **exceptional contribution** in any field of science and technology. **Hence pair 2 is correctly matched.**
- **Vigyan Team (VT) award** to be given to a team comprising of three or more scientists/ researchers/innovators who have made an **exceptional contribution** working in a team in any field of science and technology.

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