

APPROACH – ANSWER: G. S. MAINS MOCK TEST - 1813 (2022)

Answer all the questions in NOT MORE THAN 200 WORDS each. Content of the answers is more important than its length. All questions carry equal marks. 12.5X20=250

1. Explain the process of sea floor spreading. Also, discuss the various evidences that support it.

Approach:

- Briefly write about the sea floor spreading and explain its mechanism.
- Discuss the various evidences that support it.
- Conclude on the basis of above points.

Answer:

Sea floor spreading is a geological process occurring along mid-oceanic ridges i.e. **divergent plate boundaries**, in which tectonic plates move away from each other **creating new oceanic crust**.

Sea floor spreading is a tectonic activity, which occurs as a **result of mantle convection**, which includes the slow, churning motion of Earth's mantle. Convection currents carry heat from the lower mantle and core towards the lithosphere. As tectonic plates slowly move away from each other, **heat from the mantle's convection currents makes the oceanic crust more plastic and less dense**. The less-dense material rises, often forming a mountain or elevated area of the seafloor. Eventually, the constant eruptions at the crest of oceanic ridges cause the rupture of the oceanic crust and this bubbled-up magma is cooled by frigid seawater to form igneous rock. Thus, the new lava wedges into the rupture, pushing the oceanic crust on either side. This rock (basalt) becomes a new part of the Earth's crust. The ocean floor thus spreads.

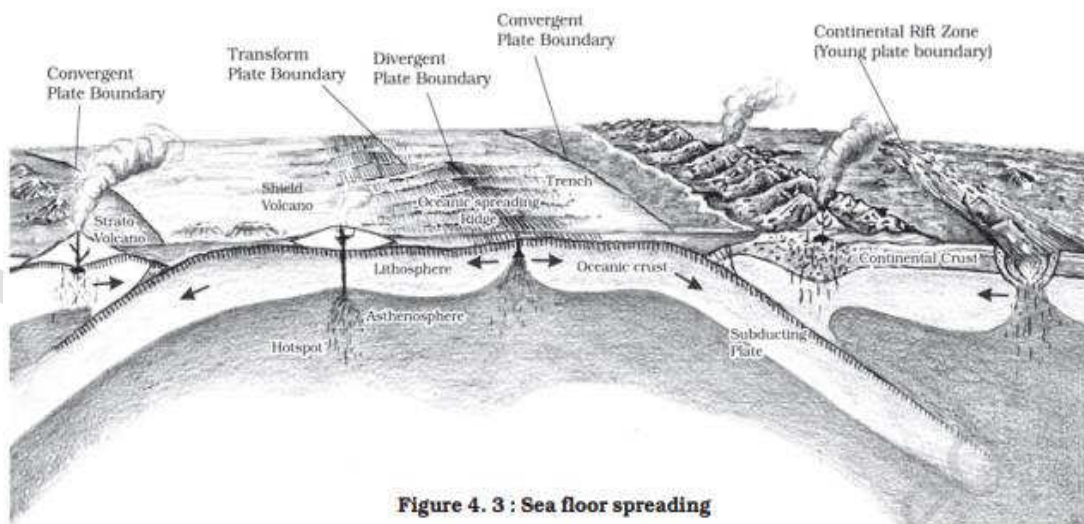


Figure 4.3 : Sea floor spreading

Evidences, which support it include the following:

- **Volcanic activity:** All along the mid-oceanic ridges, volcanic eruptions are common and they bring huge amounts of lava to the surface in this area.
- **Similar properties of equidistant rocks:** The rocks equidistant on either side of the crest of mid-oceanic ridges show remarkable similarities in terms of period of formation, chemical compositions and magnetic properties.

- **Younger age of oceanic crust:** The age of rocks in the oceanic crust is nowhere more than 200 million years old while some of the continental rock formations are as old as 3,200 million years.
- **Lesser sediments:** The sediments on the ocean floor are unexpectedly very thin and nowhere found to be older than 200 million years. If the ocean floors were as old as the continent, there would have been a complete sequence of sediments for a period of much longer duration.
- **Shallow earthquakes:** The deep trenches have deep-seated earthquake occurrences while in the mid-oceanic ridge areas, the earthquake foci have shallow depths.

These evidences along with a detailed study of magnetic properties of the rocks on either side of the mid-oceanic ridge led to the hypothesis of “sea floor spreading” by Harry Hess.

2. Give a brief account of distribution of iron ore and manganese found in India.

Approach:

- Give a brief background on iron and manganese resources.
- Discuss the distribution of iron ore in India.
- Discuss the distribution of manganese in India.
- Conclude by highlighting their significance for India.

Answer:

Iron ore and manganese are examples of ferrous minerals, which provide a strong base for the development of metallurgical industries.

Distribution of iron ore in India:

- The two main types of iron ore found in India are haematite and magnetite. The iron ore mines occur in close proximity to the coal fields in the eastern plateau region of the country, which adds to their advantage. In **Odisha**, iron ore occurs in a series of hill ranges in Sundergarh, Mayurbhanj and Jhar.
- Similarly, hill ranges in **Jharkhand** have some of the oldest iron ore mines, such as Noamundi and Gua mines located in Poorbi and Pashchimi Singhbhum districts. This belt further extends to **Chhattisgarh** in the districts of Durg, Dantewada and Bailadila. Dalli and Rajhara in Durg are the important mines of iron ore in the country.
- In **Karnataka**, iron ore deposits occur in Sandur-Hospet area of Ballari district, Baba Budan hills and Kudremukh in Chikkamagaluru district and parts of Shivamogga, Chitradurg and Tumakuru districts. The districts of Chandrapur, Bhandara and Ratnagiri in **Maharashtra**, Karimnagar and Warangal district of **Telangana**, Kurnool, Cuddapah and Anantapur districts of **Andhra Pradesh**, Salem and Nilgiris districts of **Tamil Nadu** are other iron mining regions. **Goa** has also emerged as an important producer of iron ore.

Distribution of manganese in India:

- Manganese deposits are found in almost all geological formations; however, it is mainly associated with the **Dharwar system**. **Odisha** is the leading producer of manganese with major mines being located in the central part of the iron ore belt of India, particularly in Bonai, Kendujhar, Sundergarh, Gangpur, Koraput, Kalahandi and Bolangir.
- **Karnataka** is another major producer and here the mines are located in Dharwar, Ballari, Belagavi, North Canara, Chikkamagaluru, Shivamogga, Chitradurg and Tumakuru. **Maharashtra** is also an important producer of manganese, which is mined in Nagpur, Bhandara and Ratnagiri districts. However, these mines of Maharashtra are located far from steel plants. Additionally, the manganese belt of **Madhya Pradesh** extends in a belt in Balaghat-Chhindwara-Nimar-Mandla and Jhabua districts.
- **Telangana, Goa, and Jharkhand** are other minor producers of manganese.

India is well placed in respect of both iron ore and manganese- in terms of reserves and production. Manganese is an important raw material for smelting of iron ore and is also used for manufacturing ferro-alloys. India has the largest reserve of iron ore in Asia and it has great demand in the international market due to its superior quality.

3. **Highlighting the role of seismic waves in its understanding, describe the different layers of earth's internal structure.**

Approach:

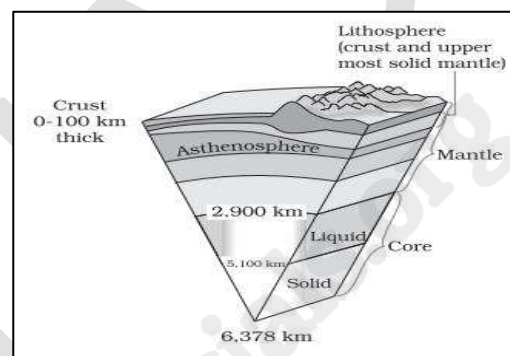
- Explain the meaning of seismic waves.
- Mention the role of seismic waves in understanding the Earth's internal structure.
- Describe different layers of Earth's internal structure.
- Conclude on the basis of above points.

Answer:

An earthquake is the shaking of the surface of the earth, which is caused due to a sudden release of energy in the Earth's lithosphere, which generates seismic waves that travel in all directions. The study of propagation of seismic waves provides a picture of the earth's layered interior.

Role of seismic waves in understanding the Earth's internal structure:

- Seismic waves move faster through denser or more rigid material and vice versa. Thus, they help in studying the **density, rigidity and compressibility** of various layers.
- The abrupt increase in speed of seismic waves when they move from one layer to another helps in assessing **the thickness of various layers**. For example, there is an abrupt increase in seismic wave speed at the boundary between crust and mantle.
- P-waves slow down at the mantle-core boundary. This means that the **outer core is less rigid than the mantle**.
- S-waves can only propagate through solids. They cannot travel through liquids and disappear at the mantle-core boundary. Thus, it proves that the **outer core is in a liquid state**.
- There is an abrupt increase in the speed of P-waves while passing through the inner core. It means that the inner core is more rigid than the outer core. Also, it has been found that the **inner core is probably a crystalline or solid mass**.



Different layers of the Earth's internal structure:

Crust	Mantle	Core
<ul style="list-style-type: none"> • It is the outermost, solid part of the earth. • It is brittle in nature. • It is of two types: oceanic and continental. • Oceanic crust is thinner as compared to the continental crust. The mean thickness of oceanic crust is 5 km whereas that of the continental crust is around 30 km. • The type of rock found in the oceanic crust is basalt and that in continental crust is granitic. • Average density of the crust is 3 g/cm³. 	<ul style="list-style-type: none"> • The mantle extends from Moho's discontinuity to a depth of 2,900 km. • It is in a predominantly solid state. • It is composed of very dense rocks rich in olivine. • Crust and uppermost part of the mantle are called lithosphere. • The upper portion of the mantle (below the lithosphere) is a part of the asthenosphere, and the lower part mesosphere. • It has an average density of 3.4 g/cm³, which is higher than the crust. 	<ul style="list-style-type: none"> • Core extends from 2900 Km below the surface of earth till the centre. • Core is further classified into outer and inner core. • The outer core is in liquid state while the inner core is in solid state. • The core is made up of very heavy material mostly composed of nickel and iron. • The density of material at the mantle-core boundary is around 5 g/cm³ and at the centre of the earth it is around 13g/cm³.

The study of earthquake waves, along with the evidence from volcanic eruptions, deep mine operations and crustal borings, have led to the study of the internal structure of earth.

4. Give an account of the distribution of petroleum reserves in the world.

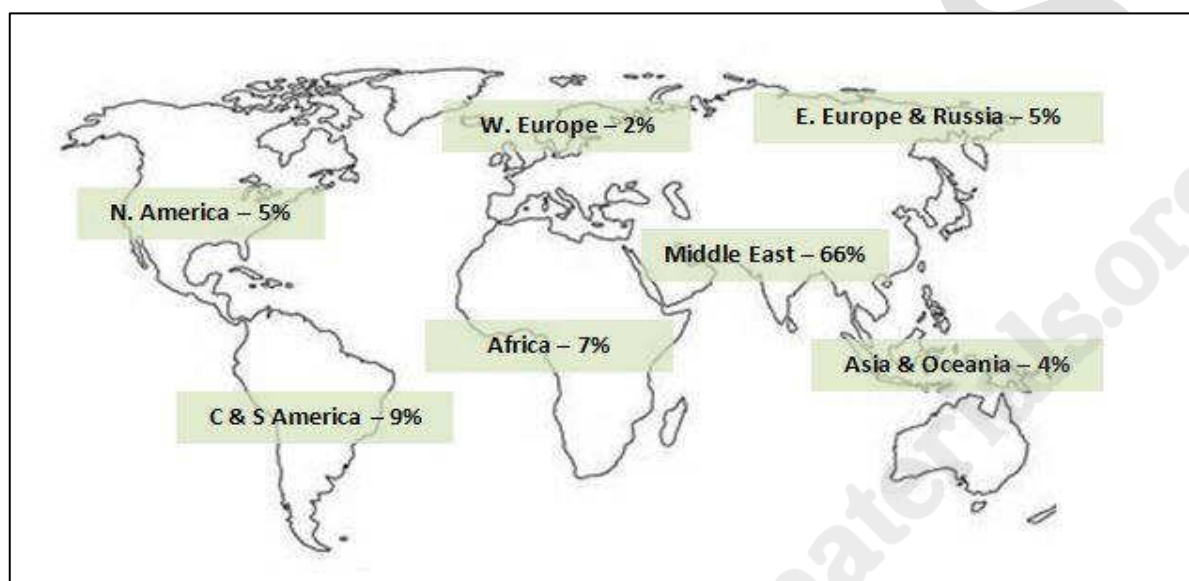
Approach:

- Briefly write about the petroleum and its reserves around the world.
- With the help of a map, mention the region wise distribution of petroleum reserves in the world.
- Conclude by highlighting the current situation of petroleum exploration.

Answer:

Petroleum is also called '**black gold**' or '**liquid gold**' because of its high value in the market. Crude petroleum occurs in **sedimentary rocks** of the tertiary period. Petroleum resources are not distributed evenly around the world. According to the U.S. Department of Energy (2015), **15 countries account for more than 75 percent of the world's oil production and hold roughly 93 percent of its reserves.**

Distribution of petroleum reserves in the world:



- Middle East – Arabian-Iranian Sedimentary Basin:** More than half of the world's proven oil reserves are located in the Middle East, including:
 - Saudi Arabia** – It has the second largest proven oil reserves in the world (approximately 16% of global reserves). Here, some important oilfields are Al-Ghawar, Saffaniyyah, etc.
 - Iraq, Kuwait, and Iran** – Together, they account for more than 23 percent of all proven reserves in the world. Important oilfields located here are Al-Burqan (Kuwait), Al-Rumaylah (Iraq), Marun (Iran), etc.
- Russia and the Caspian Sea region:**
 - Russia** – It accounts for 6 % of the world's total proven reserves and is one the world's leading petroleum producers. Reserves are present in Western Siberia, Yenisey Khatanga, Kamchatka peninsula, Sakhalin Island and Volga-Caspian Region. Major oilfields in this region are Samotlor, Romashkino.
 - Kazakhstan** – It possesses approximately 3% of global oil reserves. Oilfields: Kashagan, Tengiz, etc.
- Sub-Saharan Africa:** The majority of Sub-Saharan recoverable petroleum reserves and giant oilfields are in Nigeria, Angola, Equatorial Guinea and Gabon. Important oilfields of the region include Oloibiri (Nigeria), Dalia (Angola), Zafiro (Equatorial Guinea), Rabi-Kounga (Gabon), etc.
- North America:**
 - United States of America** - It accounts for approximately 2% of the world's total proven reserves. Important oilfields are Prudhoe Bay Oilfield, Permian Basin etc.
 - Mexico** - It is one of the top 10 oil producers in the world. The major oilfields here are Cantarell, Chicotepec.
 - Canada** - Apart from conventional liquid crude oil, Canada also has huge deposits of oil sands in the Athabasca region in western Canada. Here, important oilfields are Hibernia, Terra Nova, White Rose.

5. South America:

- a. **Venezuela** - It has the world's largest oil endowment, however, they are in the form of extra-heavy oil and bitumen deposits (sour crude). It is also the largest oil exporter in the Western Hemisphere. Most of the oil reserves are located in the Orinoco belt. Some important oilfields located here are Bolivar Coastal field, Maracaibo basin.
- b. **Brazil** - It has the second largest proven oil reserves in South America. Most of the oilfields are located in the Campos and Santos basins.
6. **North Sea**: The UK has the largest proven oil reserves in the European Union. Important oilfields of the region include Forties Field (UK), Ekofisk (Norway), etc.
7. **India**: India has around 0.3% of the global oil reserves. Mumbai High, Gujarat (Ankeleshwar) and Assam (Digboi, Naharkatiya and Moran-Hugrijan) are the major petroleum production areas.

Apart from the above-mentioned reserves, there is a huge scope for exploration and production in the Arctic region of the Northern Hemisphere. However, it must be noted that the sector is facing constraints because of the growing demand for renewable energy in the wake of global warming and increasing air pollution.

5. *Identify, with examples, the factors responsible for location of iron and steel industry in India.*

Approach:

- Briefly write about the iron and steel industry in India.
- With the help of examples, discuss the factors responsible for location of the iron and steel industry in India.
- Conclude on the basis of the above points.

Answer:

India is the world's second-largest producer of steel and fourth-largest producer of iron ore. The iron and steel industry has been a major contributor to India's manufacturing output.

The factors responsible for location of iron and steel industry in India include:

- **Availability of raw materials:** In the iron and steel industry, both iron ore and coal are **weight-losing raw materials**. Therefore, an optimum location for iron and steel industries should be near raw material sources. This is why most of the iron and steel industries are located **either near coalfields** (Bokaro, Durgapur, etc.) or **near sources of iron ore** (Bhadrahati, Bhilai, and Rourkela).
- **Proximity to market:** Transport cost per tonne-kilometre of steel products is about three times more than that of coal or iron ore. Thus, setting up steel plants near the market will **reduce the transportation costs**. Further, use of scrap as raw material after the increasing popularity of open-hearth process also favours location of the industry near the markets.
- **Availability of water resources:** Water is used in the industry for **cooling purposes**. For example, Tata Iron and Steel plant in Jamshedpur uses water from Subarnarekha and Kharkai rivers. Similarly, Durgapur steel plant in West Bengal uses water from Durgapur barrage built on the Damodar river.
- **Access to energy sources:** The iron and steel industry requires a substantial amount of power/energy, thus, availability of power resources is a factor affecting its location. For example, thermal power is used by Bhilai steel plant (Korba Power plant) and hydroelectric power is used by Visvesvaraya Iron and Steel Plant (Sharavati power project), Durgapur Steel Plant, etc.
- **Availability of ports:** When some raw materials are to be imported or finished steel is to be exported, port locations are preferred. Also, the hinterland area of the port **provides a market for the industry**. For example, Vishakhapatnam Steel Plant is located at a seaport. A few more plants in the offing such as Mangalore and Ratnagiri also favour seaboard locations.
- **Transportation facilities:** Areas with adequate transportation infrastructure and connectivity are preferred for the location of the iron and steel industries. For example, the three plants of the Indian Iron and Steel Company (IISCO) are located along the Kolkata-Asansol railway line.

- **Availability of cheap labour:** Cheap labour from the tribal areas of Jharkhand, Odisha and Chhattisgarh has been an important consideration for establishment of iron and steel industries in these areas.

Almost all sectors of the Indian industry depend heavily on the iron and steel industry for their basic infrastructure, thus, the development of iron and steel industry is crucial for the overall development of India.

6. Describe the major types of volcanoes along with their characteristics.

Approach:

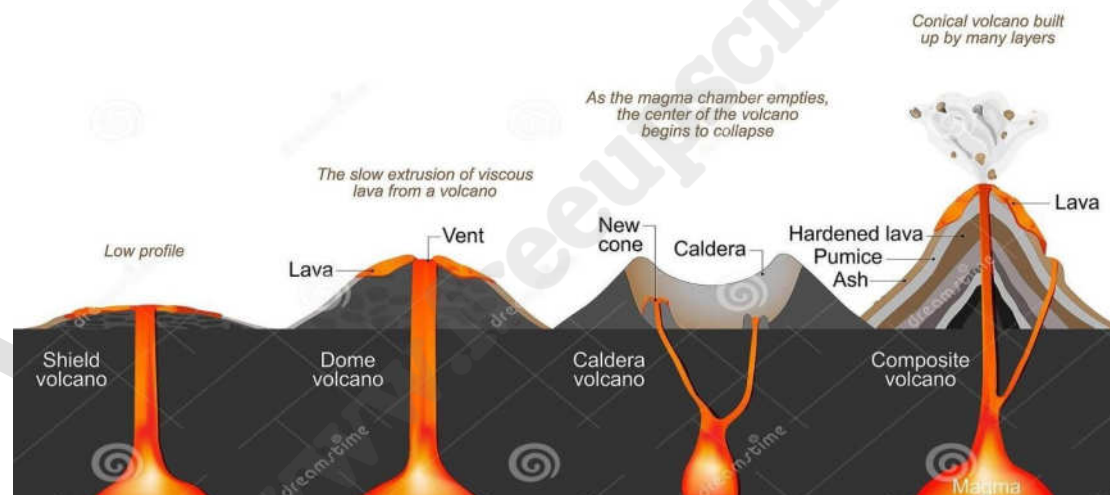
- Briefly explain what you understand by volcanoes.
- Highlight the characteristics of major types of volcanoes. Also, substantiate them with examples.
- Conclude the answer appropriately.

Answer:

A volcano is an opening in the earth's upper layer (crust) through which gases, ashes and/or molten rock material (lava) trapped under the asthenosphere (upper layer of the mantle) erupt and form several types of landforms. These are classified on the basis of the nature of eruption and the form developed at the surface. Some of the major types of volcanoes and their characteristics are as follows:

Shield volcanoes:

- These volcanoes are mostly made up of basalt, a type of lava that is very fluid when erupted. For this reason, these volcanoes are **not steep** and **have gentle slopes** around the vent.
- They **form one of the largest volcanoes on earth** (except the flood basalt provinces).
- Generally, they have **low-explosivity** but sometimes get explosive when water gets into the vent.
- The upcoming **basalt lava** moves in the form of a fountain which spreads around the vent and develops into a **cinder cone**.
- Example: Hawaiian volcanoes such as Mauna Loa and Kilauea.



Composite volcanoes:

- They release **cooler and more viscous lava** (as compared to basalt), which accumulates in the vicinity of the vent openings.
- The successive release of lava and frequent cooling leads to **formation of layers**, which makes the mounts appear like a composite volcano. They are often called **strato-volcanoes**.
- While coming out of the vent, the lava gets deposited at the opening and often results in explosive eruptions.
- Example: Mt. Etna, Mt. Stromboli, Mt. Vesuvius.

Calderas:

- When **volcanoes erupt explosively and collapse on themselves** rather than building any tall structure, the collapsed depressions are called calderas.
- These are the **most explosive of the earth's volcanoes**.
- Water may collect in the crater or caldera forming crater or caldera lakes, for example, Lake Toba in Sumatra.

Flood basalt provinces:

- These volcanoes outpour **highly fluid lava** that flow for long distances.
- Sometimes there can be a series of flows with some flows attaining thickness of more than 50 meter and spread for hundreds of kilometers.
- Example: the Deccan Traps covering most of the Maharashtra plateau, great lava plains of the Snake basin, USA.

Mid-ocean ridge volcanoes:

- These volcanoes **occur in the oceanic areas**.
- There is a system of mid-ocean ridges more than 70,000 km long that stretches through all the ocean basins. The central portion of this ridge experiences frequent eruptions.

Depending on the location of cooling of the lava, the volcanic landforms are classified as extrusive landforms (cooling at the surface) and intrusive landforms (cooling in the crust). These volcanic processes, on the one hand, severely affect human life, environment and ecology, while on the other hand, lead to production of fertile soil and deposition of minerals.

7. *Provide an account of the major fishing grounds in the world and identify the factors responsible for their distribution.*

Approach:

- Briefly mention the contribution of fishing for the global economy.
- List the major fishing grounds of the world.
- Discuss the factors influencing the location of the major fishing grounds of the world.
- Conclude the answer appropriately.

Answer:

According to the OECD, oceans contribute \$1.5 trillion annually in value-added to the overall economy with about 60 million people engaged in fishing and fish-farming globally. Fishing zones in the Pacific, Atlantic and Indian oceans regions account for around 50, 40 and 5 percent of world fish catch respectively.

Some of the major fishing grounds of the world are as follows:

- **The North – West Pacific Region:** It lies at the convergence of **Kuroshio (warm) and Oyashio (cold) currents**. The region extends southward from the outer Aleutian Islands in the north to the central Pacific, north of the Philippine Islands.
- **The North – East Atlantic and adjacent waters of the Arctic:** It extends from Iceland to Mediterranean coasts including Norway, Denmark, Spain, Iceland and the United Kingdom. Here, Dogger Bank witnesses fishing throughout the year.
- **The South – East Pacific Region:** The north flowing **Peru Current** provides an ideal environment as it is associated with a coastal upwelling of nutrient rich colder water laden with plankton.
- **The North – East Pacific Region:** The region extends from Alaska to California along the western shores of North America.
- **The West Central Pacific Region:** It extends from the Philippines and Indonesia southward to the Australian coast. This area, together with the Indian Ocean, comprises a major marine region.
- **The North – West Atlantic Region:** It lies at the convergence of the **Gulf Stream** and the **Labrador Current**. The region extends along the eastern coast of Canada and USA and includes the Grand Bank and the Georges Bank area of the Northwest Atlantic.

The location of these major fishing grounds of the world **is influenced by the several factors such as:**

- **Mixing of warm and cold currents** brings nutrients and helps to replenish the oxygen level in the ocean water. It favors the growth of primary producers such as phytoplankton, which is the primary food for fish population.
- **Upwelling** involves wind-driven motion of dense, cooler, and nutrient-rich water towards the ocean surface, replacing the warmer nutrient-depleted surface water. It stimulates the growth and reproduction of plankton.
- **Continental shelves** shallowness allows sunlight to penetrate through the water, which encourages the growth of minute plants and organisms like planktons.
- **Ocean currents** act as distributing agents of nutrients, oxygen and other elements across the oceans for the survival and reproduction of fishes. It also transports planktons from one area to another area.

However, the threats like climate change, pollution and overfishing are taking a heavy toll on fishing regions, reducing productivity and damaging the marine ecosystems.

8. What are the major factors that influence the location of the fertilizer industry in India? Explain with the help of suitable examples.

Approach:

- Introduce by giving a brief background on the importance of the fertilizer industry.
- Mention the location factors, giving examples.
- Conclude appropriately.

Answer:

Indian soils are generally deficient in fertilizing elements such as nitrogen, phosphorus and potassium, which result in lower farm yields. It is, therefore, essential to feed these soils with chemical fertilizers in order to improve its productivity.

The various factors that influence the location of fertilizer industry are:

- **Raw Material:** The localisation of the fertilizer industry is closely related to petrochemicals. About 70 per cent of the plants producing nitrogenous fertilizer use naphtha as the basic raw material. Therefore, most of the fertilizer plants are located near the oil refineries. Example, Panipat (Haryana), Vadodara and Kalol (Gujarat)
 - However, some fertilizer plants draw their feedstock from steel slug as well as coke and lignite. Example, Hubli and Mandya in Karnataka.
 - Phosphatic fertilizer plants are primarily dependent upon mineral phosphate, which is available in Uttar Pradesh, Madhya Pradesh and Rajasthan.
- **Energy source:** For the production of urea and nitrogen based fertilizers, natural gas is a necessity.
 - Methane obtained from coal seams and during coal production is used for manufacturing ammonia, which is then used for making nitrogen-based fertilizers like urea.
- **Market:** Due to intensive cultivation in the Indo-Gangetic plains, rate of Fertilizer consumption has increased especially in the Green Revolution belt. This has necessitated the dispersion of industry towards consumer centers such as Gorakhpur, Panipat etc.
- **Transport:** Ease of transport through Hazira-Vijaipur-Jagdipshpur (HVJ) gas pipeline and rail has facilitated diversification of this industry at Vijaypur, Jagdalpur, Aonla, Gadipani, Babrala and Shahjahanpur
- **Governmental support:** Fertiliser subsidy by government has also incentivized decentralized fertilizer production near the consumer centers such as Nangla and Bhatinda in Punjab,
- **Port:** Most of the urea-based fertilizers are imported and therefore, port facilities also impact the location of the fertilizer industry. Example, Ennore and Ranipet in Tamil Nadu.

Thus, the fertilizer industry is no more bound to the hitherto raw material rich regions. New set of demand and supply side factors coupled with favourable government policies play a crucial role in determining its final location.

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9. *Identify the different erosional landforms that are shaped by running water and groundwater.*

Approach:

- Write a brief introduction on geomorphic agents.
- Identify different erosional landforms that are shaped by running water
- Identify different erosional landforms that are shaped by groundwater.

Answer:

The geomorphic agents like running water, ground water, wind, glaciers, waves create several kinds of erosional landforms.

Erosional landforms by running water

- **Valleys:** Overland flow causes sheet erosion leading to the gradual formation of small and narrow rills.
 - Valleys start as small and narrow **rills**; the rills will gradually develop into long and wide gullies; the **gullies** will further deepen, widen and lengthen to give rise to **valleys**.
 - Depending upon dimensions and shape, many types of valleys like **V-shaped valley, gorge, canyon**, etc. can be recognised.
- **Potholes and Plunge Pools:** Over the rocky beds of hill-streams, more or less **circular depressions called potholes** form because of stream erosion aided by the abrasion of rock fragments. Once a small and shallow depression forms, pebbles and boulders get collected in those depressions and get rotated by flowing water and consequently the depressions grow in dimensions.
 - **At the foot of waterfalls** also, large potholes, quite deep and wide, form because of the sheer impact of water and rotation of boulders. These are called **plunge pools**.
- **Incised or Entrenched Meanders:** Streams flowing over gentle slopes, develop sinuous or meandering courses because of active lateral erosion. It is common to find meandering courses over floodplains and delta plains where stream gradients are very gentle.
 - Very deep and wide meanders can also be found cut in hard rocks. Such meanders are called **incised or entrenched meanders**.
- **River Terraces:** River terraces are surfaces marking old valley floor or floodplain levels. River terraces are basically products of erosion as they result due to vertical erosion by the stream into its own depositional floodplain.
 - There can be a number of such terraces at different heights indicating former river bed levels. The river terraces may occur at the same elevation on either side of the rivers in which case they are called **paired terraces**.

Erosional landforms by groundwater

- **Sinkholes, Lapies and Limestone Pavements**
 - A **sinkhole** is a surface depression in a region of limestone or chalk terrain. Some of these form solely through solution action (solution sinks) and others might start as solution forms first and if the bottom of a sinkhole forms the roof of a void or cave underground, it might collapse leaving a large hole opening into a cave or a void below (collapse sinks).
 - The highly corrugated and rough surface of limestone lithology characterized by low ridges and pinnacles, narrow clefts and numerous solution holes is called **lapies**.
 - The lapie field may eventually turn into somewhat smooth **limestone pavements** when clefts become deeper, cutting the surface in roughly rectangular blocks.
- **Caves:** In areas where there are alternating beds of rocks (shales, sandstones, quartzites) with limestones or dolomites in between or in areas where limestones are dense, massive and occurring as thick beds, cave formation is prominent. Water percolates down either through the materials or through cracks and joints and moves horizontally along bedding planes. It is along these bedding planes that the limestone dissolves and long and narrow to wide gaps called caves result.

10. Give an account of the ecological services provided by wetlands and reasons behind their decline. What steps have been taken by the government to protect wetlands?

Approach:

- Give a brief introduction about wetlands.
- Highlight the ecological services provided by wetlands.
- Give the reasons behind their decline.
- Mention the steps that have been taken by the government to protect wetlands.
- Give a brief conclusion.

Answer:

Wetlands are defined as transitional lands between terrestrial and aquatic eco-systems where the water table is usually at or near the surface or the land is covered by shallow water.

While covering only 6% of the Earth's surface, wetlands provide a disproportionately high number of ecosystem services, in addition to maintaining biodiversity. These include:

- **Flood control:** They act as a barrier to absorb excess water.
- **Groundwater replenishment:** Wetland systems are directly linked to groundwater and a crucial regulator of both the quantity and quality of water found below the ground.
- **Shoreline stabilisation and storm protection:** Tidal and inter-tidal wetland systems protect and stabilize the coastal zones. They provide a protective barrier to the coastal shoreline.
- **Nutrient retention:** Wetland vegetation uptake and store nutrients found in the surrounding soil and water.
- **Water purification:** Many wetland systems possess biofilters, hydrophytes, and organisms that have the capacity to remove toxic substances that have come from pesticides, industrial discharges, and mining activities.
- **Climate change mitigation and adaptation:** They have mitigation effects through their ability to sink carbon, and adaptation effects through their ability to store and regulate water.

Despite its importance, the world has lost around 87% of natural wetlands since the 1700s and 35% have disappeared since the 1970s. It is estimated that wetlands are vanishing three times faster than forests and their rate of disappearance is increasing. The reasons for decline are tabulated below:

Anthropogenic causes:	Natural causes:
<ul style="list-style-type: none"> • Drainage for agriculture, forestry and mosquito control • Dredging and stream channelization for navigation and food protection • Aquaculture/mariculture • Construction of dykes, dams and seawalls for flood control • Discharge of pesticide, herbicide, nutrients from domestic sewage • Ground water abstraction • Sediment diversion by dams, deep channels • Hydrological alterations by canals, roads and other structures • Subsidence due to extraction of ground water oil, gas and other minerals and mining of wetlands for peat, coal, gravel etc. 	<ul style="list-style-type: none"> • Subsidence due to earthquakes, sea level rise etc. • Drought • Hurricane and other storms • Erosion • Biotic effects (natural as well as induced due to disturbances)

Measures taken by government to protect wetlands

- India is a party to the **Ramsar Convention**, an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.
- **Wetlands (Conservation and Management) Rules, 2017** serve as a regulatory framework for conservation and management of wetlands in India.
- **The Indian Environment (Protection) Act, 1986** provides protection and improvement of the environment, including inter-alia, wetlands.
- **The National Environment Policy, 2006** recognises the ecosystem services provided by wetlands and emphasises the need to set up a regulatory mechanism for all wetlands.

National Wetland Inventory and Assessment (NWIA) was conducted in the country using Indian remote sensing satellites during 2006-2011. Subsequently, national and state-level wetland inventory atlases were released which have spatial data on wetlands for each state and union territory.

- **The National Wetlands Conservation Programme** has been in operation since 1986. Since 2013, the programme has been known as the **National Plan for Conservation of Aquatic Ecosystems**.
- The Ministry of Jal Shakti operates a **scheme for Repair, Renovation and Restoration of Water Bodies**.
- The central government provides **assistance to state governments** for implementation of management plans for prioritized wetlands.

Apart from the government, citizens too need to undertake efforts to protect and improve the natural environment. Individual initiatives combined with government support would go a long way in protecting these ecosystems.

11. Highlight the various factors affecting salinity of the oceans. Also, elaborate upon horizontal and vertical distribution of ocean salinity.

Approach:

- Introduce by defining the term salinity.
- List the factors affecting salinity of the oceans.
- Highlight the meaning of horizontal and vertical distribution of ocean salinity.
- Conclude appropriately.

Answer:

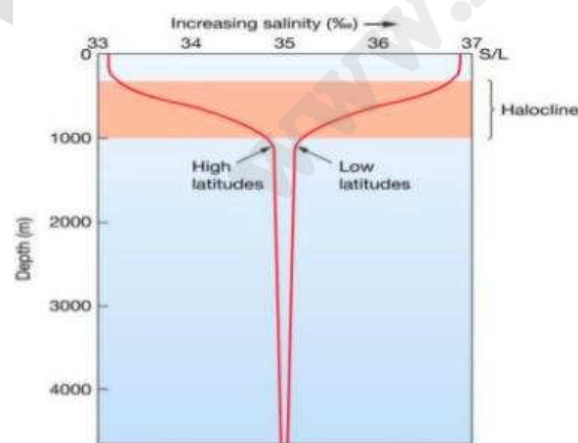
Salinity is the total content of dissolved salts in sea water and is calculated as the amount of salt (in gm) dissolved in 1,000 gm (1 kg) of seawater. It is usually expressed as parts per thousand or ppt.

Factors Affecting Ocean Salinity

- The salinity of water in the surface layer of oceans depends mainly on **evaporation and precipitation**.
- Surface salinity is greatly influenced in coastal regions by the **freshwater flow from rivers**, and in polar-regions by the processes of **freezing and thawing of ice**.
- **Wind** also influences salinity of an area by transferring water to other areas.
- The **ocean currents** contribute to the salinity variations.
- Any **change in the temperature or density of water** influences the salinity of water in an area.

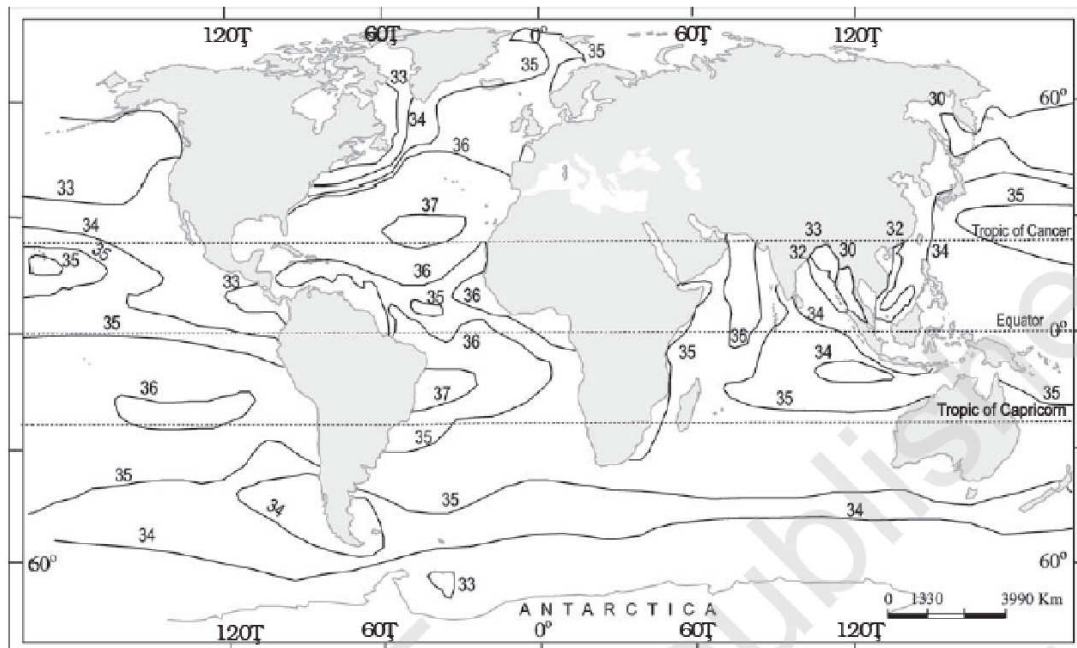
Vertical distribution of salinity:

Salinity at the surface increases by loss of water to ice or evaporation, or decreases by the input of fresh water, such as from the rivers. In contrast, salinity at depth remains largely fixed.



∴ Vertical distribution of salinity in the ocean.

Salinity, generally, increases with depth and there is a distinct zone called the **halocline**, where **salinity increases sharply**. Other factors being constant, increasing salinity of seawater causes its density to increase. High salinity seawater, generally, sinks below the lower salinity water. This leads to **stratification** by salinity.



Horizontal distribution of salinity

The salinity for normal open ocean ranges between 33 ppt and 37 ppt. In the land-locked Red sea, it is as high as 41 ppt, while in the estuaries and the Arctic, the salinity fluctuates from 0 – 35 ppt, seasonally. In hot and dry regions, where evaporation is high, the salinity sometimes reaches 70 ppt. For instance, the Mediterranean Sea records higher salinity due to high evaporation. Similarly, salinity variation in the Pacific Ocean is mainly due to its shape and larger areal extent. It decreases from 35 ppt - 31 ppt on the western parts of the northern hemisphere because of the influx of melted water from the Arctic region. In the same way, after 15° - 20° south, it decreases to 33 ppt.

The average salinity of the Indian Ocean is 35 ppt. The low salinity trend is observed in the Bay of Bengal due to large influx of river water. On the contrary, the Arabian Sea shows higher salinity due to high evaporation and low influx of fresh water.

12. *Differentiate between conventional and non-conventional sources of energy. Also, list some advantages and disadvantages of non-conventional sources of energy.*

Approach:

- List down the differences between conventional and non-conventional sources of energy.
- Discuss the various types of non-conventional sources of energy.
- Discuss the advantages and disadvantages of each of them.
- Conclude appropriately.

Answer:

A source of energy is anything out of which usable energy can be extracted. There are a variety of sources that provide us energy for different purposes. Consequently, sources of power may be broadly categorised as conventional and non-conventional resources.

The key differences between conventional and non-conventional sources of energy can be listed as under:

Conventional sources	Non-conventional sources
Conventional sources of energy are those, which have been in common use for a long time. Firewood and fossil fuels are the two main conventional energy sources.	In comparison to conventional sources, non-conventional sources are rather new. E.g. solar, tidal, wind, nuclear, bio-resources, geothermal resources.
Since these are non-renewable sources, they cannot be replenished by natural processes and take a significant amount of time for formation.	These sources of energy are replenished by natural processes.
These are finite sources and hidden.	These sources are reliable and plentiful.
Their consumption releases large amounts of pollutants and greenhouse gases.	These are clean sources that do not produce greenhouse gases or pollutants.
These sources require low maintenance cost.	The maintenance cost associated with these are higher.
These sources have high energy density.	These sources have low energy density.
These sources are going to become costlier as resources dwindle.	These sources are unlimited and with improvements in technology are going to become cheaper.

The various types of non-conventional sources of energy also bring with them several advantages and disadvantages as discussed below:

Sources	Advantages	Disadvantages
Wind energy	<ul style="list-style-type: none"> Non Polluting Safe and clean Low cost of production of electricity once setup 	<ul style="list-style-type: none"> Noise pollution High upfront cost for setup. Harmful for birds Disturbs TV and radio reception
Solar energy	<ul style="list-style-type: none"> Non-exhaustible Non-polluting 	<ul style="list-style-type: none"> Expensive source of energy Solar energy is diffused and hence a lot of potential gets wasted
Tidal energy	<ul style="list-style-type: none"> Non-exhaustible Non-polluting 	<ul style="list-style-type: none"> Difficult to harness Destroys wildlife habitats
Nuclear energy	<ul style="list-style-type: none"> Emits huge amount of energy 	<ul style="list-style-type: none"> Creates radioactive waste Expensive source of energy to set up
Bio-gas	<ul style="list-style-type: none"> Low cost Easy to operate Generates energy from bio-waste 	<ul style="list-style-type: none"> Greenhouse effect
Geo-thermal Energy	<ul style="list-style-type: none"> Clean source and hence, eco-friendly Always available and hence sustainable 	<ul style="list-style-type: none"> Located far away from cities and hence expensive to transport over long distances.

As the world is increasingly focusing on sustainable growth and development, the non-conventional sources of energy will be the future of the energy sector in the days to come.

13. State the characteristic features of equatorial climate and vegetation. Discuss, why the equatorial region remains underdeveloped despite having abundance of natural resources.

Approach:

- Briefly state the extent of the Equatorial climate regions.
- Mention the characteristic features of the Equatorial climate.
- Similarly, mention the characteristic features of Equatorial vegetation.
- State the reasons that have constrained the development of the region despite abundance of natural resources.

Answer:

The hot and wet equatorial climate is found between 5° to 10° North and South of the Equator, primarily in the Amazon lowlands, the Congo, Malaysia and the East Indies.

Characteristic features of the Equatorial climate include:

- Temperature and seasons:** There is great uniformity of temperature throughout the year, with mean monthly temperature always around 80° F. Diurnal and annual ranges of temperatures

are also small due to cloudiness, heavy precipitation and land and sea breezes. Thus, there is no distinct winter or summer season.

- **Precipitation:** Precipitation is heavy and well distributed throughout the year between 60-100 inches with two periods of maximum rainfall in April and October, shortly after the equinoxes. Least rainfalls occur during June and December solstices. Thunder and lightning often follow convectional rains in the afternoon.

Characteristic features of the Equatorial vegetation are:

- **Variety of vegetation:** Such regions are characterised by a great variety of vegetation including evergreen trees, smaller trees, climbing plants, epiphytic and parasitic plants etc.
- **Distinct layer arrangement:** All plants struggle upwards for sunlight resulting in a layered arrangement.
- **Multiple species:** The trees of the forest are not found in pure strands of a single species but in multiple strands of different species.

Factors that constrain the development of the region despite having abundant resources are:

- **Equatorial climate and health:** Due to excessive heat and high humidity, people are subjected to physical and mental handicaps, diseases like malaria and yellow fever etc., which reduces their capacity to work.
- **Prevalence of bacteria and insect pests:** The hot, wet climate is ideal for the survival and spread of insects and pests, which injure crops and plague men and animals.
- **Hindrance to development and maintenance:** Due to luxuriant jungle, tall grass, thick undergrowth, regular weed growth etc., it is difficult to clear the forests for construction and maintenance.
- **Rapid deterioration of tropical soil:** Most of the soil nutrients are washed out due to torrential downpours, leading to soil erosion and impoverishment.
- **Difficulties in lumbering:** Commercial extraction is difficult, as the trees do not occur in homogeneous strands. Further, there are no frozen surfaces to facilitate logging of heavy tropical hardwoods.
- **Difficulties in livestock farming:** Livestock farming is handicapped by absence of meadows and frequent attacks by flies and insects.

14. Bring out the differences between tropical and temperate cyclones.

Approach:

- Write a short note defining and briefly explaining cyclones.
- Suggest the types of cyclones based on forms of location.
- List the important points of distinction between tropical and temperate cyclones

Answer:

Cyclones are centres of low pressure surrounded by closed isobars having increasing pressure outward and closed air circulation (convergent air circulation) from outside towards the central low pressure in such a way that winds blow in anti-clockwise and clockwise directions in the northern and the southern hemisphere respectively.

There are two types of cyclones based on forms of location: Tropical Cyclones and Temperate Cyclones. **The differences between tropical and temperate cyclones can be explained as under:**

	Tropical Cyclones	Temperate Cyclones
Origin	Found between 8-20° N & S. They are not formed between 8°N and 8°S because of absence of adequate Coriolis force.	Found between 30-65° N & S.
Extent	Diameter of approximately 8-12 km, have an effect on a comparative smaller area.	Found over a larger area with diameter of approximately 300- 1500 km.
Energy	More energy per unit area, pressure gradient is very steep and isobars are closely packed.	Less energy per unit area and the pressure gradient is not as steep.

Wind velocity	Excess of 120 kmph.	40-50 kmph.
Nature	Non-frontal.	Frontal.
Energy source	Latent heat of condensation.	Temperature contrast across the fronts.
Place of origin	Only over oceans and only during summers.	Over continents, oceans or both and they form during summers and winters.
Movement direction	Move from east to west	Move from west to east
Precipitation	Heavy precipitation in a narrow zone, mainly along the eye wall.	Weather changes are sequential and precipitation is evenly distributed over space and time.
Connection with Jet Streams	Connection with the jet stream is not established beyond doubt, but the subtropical jets play a role in the development of low pressure below the crest over ocean. Also, tropical easterly jet has a connection with tropical cyclones in the Andaman Sea.	Intrinsic affiliation with the formation of Rossby waves and polar front jet.
Cyclolysis	When they reach over land or cold water (sea-surface temperature below 27°C).	When complete mixing of warm and cold air masses has taken place.

15. What are the conditions that are conducive for formation of tropical and cold water corals? Highlight the anthropogenic factors that have led to their decline.

Approach:

- Introduce by giving a brief background on coral reefs.
- Mention the conditions that are conducive for formation of corals.
- Mention the anthropogenic factors that have led to their decline.
- Conclude appropriately.

Answer:

Corals are invertebrate animals belonging to a large group of **animals called Cnidaria**. Most corals contain, within their tissues, algae called **zooxanthellae, which are plant-like organisms**. Corals are sessile, which means that they permanently attach themselves to the ocean floor, essentially "taking root" like most plants do. It relies on its relationship with plant-like algae to build the largest structures of biological origin on Earth, the **coral reefs**. These are spread across tropical as well as cold waters in the oceans.

The conditions conducive for formation of coral reefs are:

- **Sunlight:** Corals depend on *zooxanthellae* (algae) that need sunlight to survive. Therefore, corals rarely develop in water deeper than 165 feet (50 meters).
- **Clear water:** Corals need clear water that lets sunlight through. They don't thrive well when the water is opaque, for instance, when sediment and plankton cloud water.
- **Warm water temperature:** Reef-building corals require warm water conditions to survive. Different corals living in different regions can withstand various temperature fluctuations. However, corals generally live in water temperatures of 68–90° F or 20–32° C.
- **Clean water:** Corals are sensitive to pollution and sediments. Sediments can create cloudy water or be deposited on corals, blocking out the sun and harming the polyps. Wastewater discharged into the ocean near the reef can contain too many nutrients that cause seaweeds to overgrow the reef.
- **Saltwater:** Corals need saltwater to survive and require a certain balance in the ratio of salt to water. This is why corals don't live in areas where rivers drain fresh water into the ocean ("estuaries").

In comparison with tropical corals, deep corals/cold water corals don't depend on warm water or sunlight. Hence, they are able to live in many different places around the world, even in waters as cold as -1°C.

- **Topography and food:** Deep corals live in high and mid-latitudes, not just in the tropics. They need no sunlight, because they do not rely on the symbiotic relationship with photosynthetic

algae. Instead, deep corals feed entirely on small plankton and organic particles—stirred up and brought to them by ocean currents that intensify when they hit undersea mountains.

Most coral reefs occur in shallow water near shore. Resultantly, they are vulnerable to the effects of human activities, including direct exploitation and indirect impact from adjacent human activities that include:

- **Physical damage or destruction** from coastal development, dredging, quarrying, destructive fishing practices and gear etc.
- **Pollution that originates on land** but finds its way into coastal waters. There are many types and sources of pollution from land-based activities, for example:
 - **Sedimentation** from coastal development, urban stormwater runoff, forestry, and agriculture
 - **Nutrients** (nitrogen and phosphorous) from agricultural and residential fertilizer use, sewage discharges (including wastewater treatment plants and septic systems), and animal waste
 - **Pathogens** from inadequately treated sewage, stormwater, and runoff from livestock pens
 - **Toxic substances**, including metals, organic chemicals and pesticides found in industrial discharges, sunscreens, urban and agricultural runoff, mining activities, and runoff from landfill.
 - **Trash and microplastics** from improper disposal and stormwater runoff
- **Overfishing** can alter food-web structure and cause cascading effects, such as reducing the numbers of grazing fish that keep corals clean of algal overgrowth. Blast fishing (i.e., using explosives to kill fish) can cause physical damage to corals as well.
- **Coral harvesting** for the aquarium trade, jewelry, and curios can lead to over-harvesting of specific species, destruction of reef habitat, and reduced biodiversity.

Coral reefs sustain a wide range of bio-diversity providing home to at least 25% of marine origin fauna. It provides many services to tourism, fisheries in addition to coastline protection from wave action. Therefore, they need to be conserved.

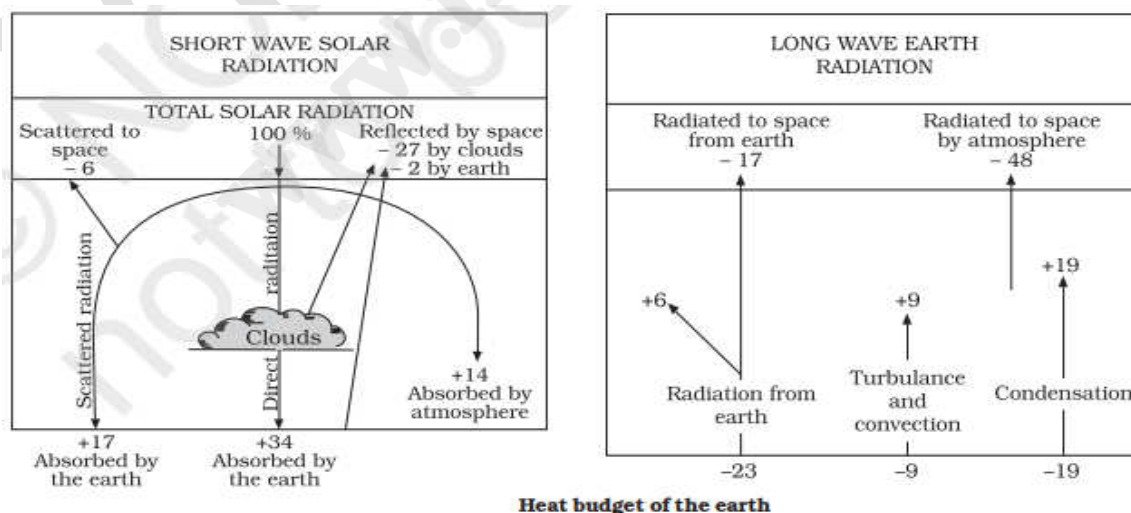
16. Explain the processes by which the Earth maintains its heat budget.

Approach:

- Briefly explain heat budget in the introduction.
- Discuss the various processes through which earth maintains its heat balance.
- Conclude accordingly.

Answer:

The earth as a whole does not accumulate or lose heat. It receives a certain amount of **insolation (short waves)** and gives back heat into space by **terrestrial radiation (long wave radiation)**. Through this exchange, or the **heat budget**, the **earth maintains a constant temperature**.



Various processes through which Earth maintains its heat budget are as follows:

- **Reflection and Scattering:** While passing through the atmosphere some amount of energy is reflected, scattered and absorbed. Only the remaining part reaches the earth surface. Consider that the insolation received at the top of the atmosphere is 100 per cent.
 - Roughly **35 units** are **reflected back** to space even before reaching the earth's surface. Of these, **27 units are reflected back from the top of the clouds and 2 units from the snow and ice-covered areas** of the earth. The reflected amount of radiation is called the albedo of the earth.
 - Roughly **6 units are scattered back to space. Total 33 units of incoming radiation are scattered**, out of which 6 units are scattered back to space and 17 units are absorbed by the earth surface.
- **Absorption and Radiation:** The remaining 65 units are absorbed, 14 units within the atmosphere and 51 units by the earth's surface.
 - The earth radiates back 51 units absorbed by the in the form of terrestrial radiation. Of these, 17 units are radiated to space directly and the remaining 34 units are absorbed by the atmosphere. Out of 34 units,
 - ✓ **6 units** absorbed directly by the atmosphere **through conduction** (transfer of heat through direct contact between the surface and the atmosphere.)
 - ✓ **9 units through convection and turbulence** (the vertical movement of air which expands and rises after being heated by radiation or conduction at lower layers of atmosphere).
 - ✓ **19 units through latent heat of condensation** (energy released when water vapor condenses to form liquid droplets).
 - 48 units absorbed by the atmosphere (14 units from insolation +34 units from terrestrial radiation) are also **radiated back into space**.

These processes explain why the earth neither warms up nor cools down despite the huge transfer of heat that takes place.

17. Elucidate the link between biodiversity and sustainable development. Also, mention steps taken by India to address the concern of biodiversity loss.

Approach:

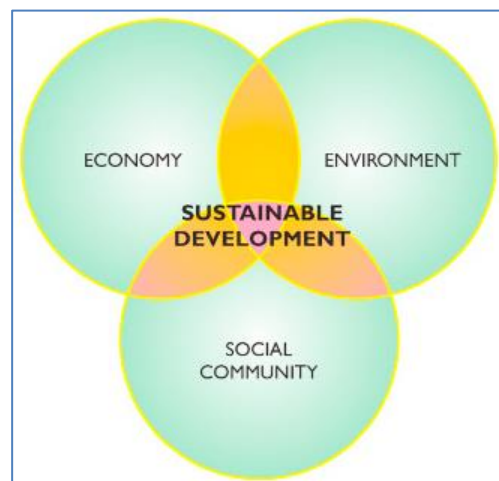
- Highlight the meaning of sustainable development in the introduction.
- Explain the role played by biodiversity in maintaining sustainable development.
- Highlight the steps taken by India to prevent biodiversity loss and conclude briefly.

Answer:

Biodiversity is defined as the **variability among living organisms** from all sources, including diversity within species, between species, and of ecosystems. It is essential for **Sustainable development or development that meets the needs of the present generations without compromising the ability of future generations** to meet their own needs. There are three pillars of sustainable development - economic growth, environmental stewardship, and social inclusion.

Biodiversity plays the following role in maintaining sustainable development:

- **Ecological Role:** Species **capture and store energy**, produce and decompose organic materials, help to cycle water and nutrients throughout the ecosystem, fix atmospheric gases and help regulate the climate.
- **Economic Role:** An important part of biodiversity is '**crop diversity**', which is also called **agro-biodiversity**. Some of the important economic commodities that biodiversity supplies to humankind are: food crops, livestock, forests, fish,



medicinal resources, cosmetic products etc.

- **Social Role:** It includes **aesthetic, recreational, cultural and spiritual values** and the related health benefits. Biodiversity is important in supporting vital **ecosystem services (ES)** such as provision of clean water and social benefits, such as improved employment. It also helps in understanding how life functions and the role of each species in sustaining ecosystems of which we are also a species.

Given the need for biodiversity and healthy ecosystems to achieve the 2030 Agenda, it is not surprising that many Sustainable Development Goals (SDGs) include targets that reflect their important role. However, there **has been a substantial loss of biodiversity across the world**, including India, due to habitat loss and fragmentation, invasive alien species, global warming, pollution and over-exploitation of resources etc.

The **steps taken by India to address it include:**

- **In-situ measures** include establishment of national parks and sanctuaries and declaration of biosphere reserves under Wild Life (Protection) Act, 1972 to protect, preserve and propagate the variety of species within natural boundaries.
- **Ex-situ measures**, including establishment of botanical gardens, zoos, conservation strands and gene, pollen seed, seedling, tissue culture and DNA banks, where threatened animals and plants are taken out from their natural habitat and placed in special settings where they can be protected and given special care.
- **Biological Diversity Act 2002** has also been enacted with the aim to conserve biological resources of the country and regulation of access to these resources to ensure equitable sharing of benefits arising out of their use.
- **Medicinal Plants Conservation Areas (MPCAs)** are specially designated primarily forested areas by the Government, which supports conservation of some prioritised/threatened medicinal plants.
- The **National Afforestation & Eco-development Board** promotes afforestation, tree planting, ecological restoration and eco-development activities in the country, with special attention to degraded areas as well as ecologically fragile areas.
- **Compensatory afforestation** on equivalent non forest land is mandated to compensate the loss of forest and biodiversity and such non forest lands are declared as Protected Forests/Reserve Forests under Indian Forest Act 1927.
- **Wetland (Conservation and Management) Rules** have been framed for the protection of wetlands, in the States.
- **Wildlife Crime Control Bureau** has been established for control of illegal trade in wildlife, including endangered species.

Further, the Central Government provides financial assistance to States and Union Territories under Centrally Sponsored Schemes such as **Integrated Development of Wildlife Habitat; Project Tiger, and Project Elephant** for better protection and conservation of wildlife and their habitat; and Identification of Forest Management Scheme towards protection and management of forests.

18. What is meant by High Technology or Hi-Tech industry? Giving examples of some of these industries, highlight their important features.

Approach:

- Define Hi-Tech industry and give its examples.
- Mention the features of Hi-Tech industries as well.
- Conclude accordingly.

Answer:

High technology industries are the **latest generation of manufacturing activities**, which involve application of intensive research and development (R&D) efforts leading to the manufacture of products of an advanced scientific and engineering character.

Few examples of hi-tech industries are **telecom and networking, computing and automation, modern pharmaceuticals, commercial jet aircraft, and advanced instrumentation** such as MRI machines. Emerging hi-tech areas include **genetic engineering and nanotechnology**. Robotics on the assembly line, computer-aided design (CAD) and manufacturing, electronic controls of smelting and refining processes, and the constant development of new chemical and pharmaceutical products are other notable examples of high-tech industry.

Features of Hi-Tech industry

- Hi-tech industries employ **highly skilled scientific and engineering personnel**
- These industries build **competitive advantage** on the basis of knowledge, intellectual capital and innovations.
- **Professional (white collar) workers make up a large share of the total workforce.** These highly skilled specialists greatly outnumber the actual production (blue collar) workers.
- The **high-tech industrial landscape is characterised by neatly spaced, low, modern, dispersed, office-plant-lab buildings** rather than massive assembly structures, factories and storage areas mark.
- **Planned business parks** for high-tech start-ups have **become part of regional and local development schemes.** **Technopolies** are **regionally concentrated, self-sustained and highly specialised high-tech industries.**
- Most of the Hi-tech industries are located around **metropolitan cities** like Silicon Forest near Seattle, because people in these areas are educated and they can learn these technologies and skills faster. So, the required resources like skilled white collar resources and transportation are easily available.

In the developed, post-industrial economies, the high technology companies sector is commonly regarded as the area with the largest use of and dependence on the so called **special means of production – knowledge and human resources**. These means are constantly created, which has enabled not only competition among individual companies but has also resulted in a positive effect on the surroundings (traditional industries, level of science, etc.).

19. *Give an account of locational factors that have influenced the distribution of jute industry in India. What are the challenges that this industry faces?*

Approach:

- Briefly write about geographical distribution of jute industry in India.
- Discuss locational factors of jute industry.
- Discuss the challenges of the jute industry.
- Conclude appropriately.

Answer:

India is the world's largest producer of raw jute. It is also known as '**Golden Fibre**'. It is primarily grown in **West Bengal, Bihar, Odisha, Assam, Meghalaya, Tripura, and Andhra Pradesh**. The Indian jute industry is mainly located in **West Bengal**, along the banks of the Hugli River with around 70 mills, while **Andhra Pradesh** stood a distant second with just around 10 jute mills along the banks of the river Godavari.

The following factors have influenced location of jute industry in India:

- **Proximity to jute producing areas:** Jute is **pure fiber** (i.e. weight of raw material = weight of end product). So, jute industry needs to be set up near jute cultivation regions.
- **Suitable climate:** The **Brahmaputra and Gangetic valley** has a **humid climate**, which is very convenient for spinning and weaving apart from cultivating jute.
- **Presence of rivers:** The jute industry, its **processing and treatment require huge amounts of water** owing to which it grew near major rivers of the states in which it is found.
- **Cost-effective transportation:** **Cheap waterways and railways** add to ease in transport at least in West Bengal.

- **Labour:** Cheap labour from West Bengal and adjoining states of Bihar, Odisha and Uttar Pradesh are found in abundance.
- **Energy:** Coal Mines located in Raniganj and Jharia serve to fulfill the power requirement for the industry.

In addition to West Bengal, jute mills are also located at **Guntur, Vishakhapatnam and Nelimarla in Andhra region** and at **Kanpur, Shahjanwan and Gorakhpur in Uttar Pradesh**. This shift came as **these regions also meet the conditions for jute industry and have cheap labour**.

However, jute industry faces several challenges which are as follows:

- **Obsolete processing technology:** The availability of quality raw jute and shrinking acreage on the one-hand and the failure of most jute mills to modernize, left the sector dependent on government's support for procurement like mandatory packaging of food grains in jute bags.
 - **Primitive, labour-intensive cultivation methods:** Practices like retting (drenching raw jute in water to extract the fibre) — a crucial determinant in raw jute quality — creates problems.
- **Lack of product diversification:** Only a section of the industry has diversified into non-packaging segments.
 - **Issues with the jute fiber:** Its raw material, i.e. jute fibre, is basically a coarse fibre and is not suitable for spinning yarn of low count. Due to its coarseness, the fibre is facing challenges in entering the diversified areas, namely, curtains, upholstery and light weight blankets, like other natural fibres.
- **Competition:** It faces stiff competition from **synthetic substitutes** and from **other competitors** like **Bangladesh, Brazil, Philippines, Egypt and Thailand**. Bangladesh exports raw and finished products to India at cheaper prices. Illegal import of yarn and twine from Bangladesh is another challenge. Owing to this, the local industries are unable to sell their products at competitive rates. It has a cascading effect on the workers who lose wages.

Jute industry being important to the economy needs to be promoted through suitable steps including developing a marketing strategy and incentivizing modernization of jute mills. The growing global concern for environment friendly, biodegradable materials has also provided an opportunity for jute products to be promoted as promising green alternative.

20. State the conditions that are conducive for the occurrence of temperature inversion. Also, highlight its consequences.

Approach:

- Introduce the answer by discussing the concept of temperature inversion.
- Discuss the factors responsible for temperature inversion.
- Discuss consequences of temperature inversion.
- Conclude appropriately.

Answer:

Temperature inversion, also called **thermal inversion**, refers to a phenomenon where the **temperature increases with elevation or tropospheric height leading to cooler air mass near the ground and warmer air at higher altitudes**. This happens in contrast with normal lapse rate where the temperature decreases with increase in height.

Conditions conducive for temperature inversion:

- **Long winter nights:** It leads to **greater terrestrial radiation from the earth** than the **insolation received** during daytime.
- **Clear skies:** It facilitates **terrestrial radiation to escape** to space unhindered, thus helping cooling of earth faster.
- **Snow covered lands:** Inversions also occur when **snow reflects the sun back up into the atmosphere in polar areas**, resulting in colder temperatures near the surface and warmer air above.

- **Landforms:** Cold air at the **hills and mountains**, produced during 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.**
- **Stable Winds and no precipitation:** These check vertical redistribution of heat in the air column thus maintaining a temperature gradient along the height.

Consequence of temperature inversion

- **Stability:** 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 winter.
- **Protecting plants from Frost:** Air drainage causes temperature inversion in **intermontane valley. It protects plants from frost damages.**
- **Precipitation:** Inversions play an **important role in determining cloud forms, precipitation, and visibility.** An inversion acts as a cap on the upward movement of air from the layers below.
- **Air pollution:** The strength and duration of the inversion has an influence on the air quality. **Air pollution accumulates until inversion disappears.** A strong and low height inversion leads to high pollutant levels, while a weak inversion will lead to lower levels.

Temperature inversions have a profound effect on our air quality, especially in today's urban environment and they help us in understanding important issues in global warming and climate change such as air pollution.