DIRECTION IAS

UPSC Q A

Set - 4

GEOGRAPHY

ANSWER

Question and Answer format with word limit

How to write answers

How to maintain word limit

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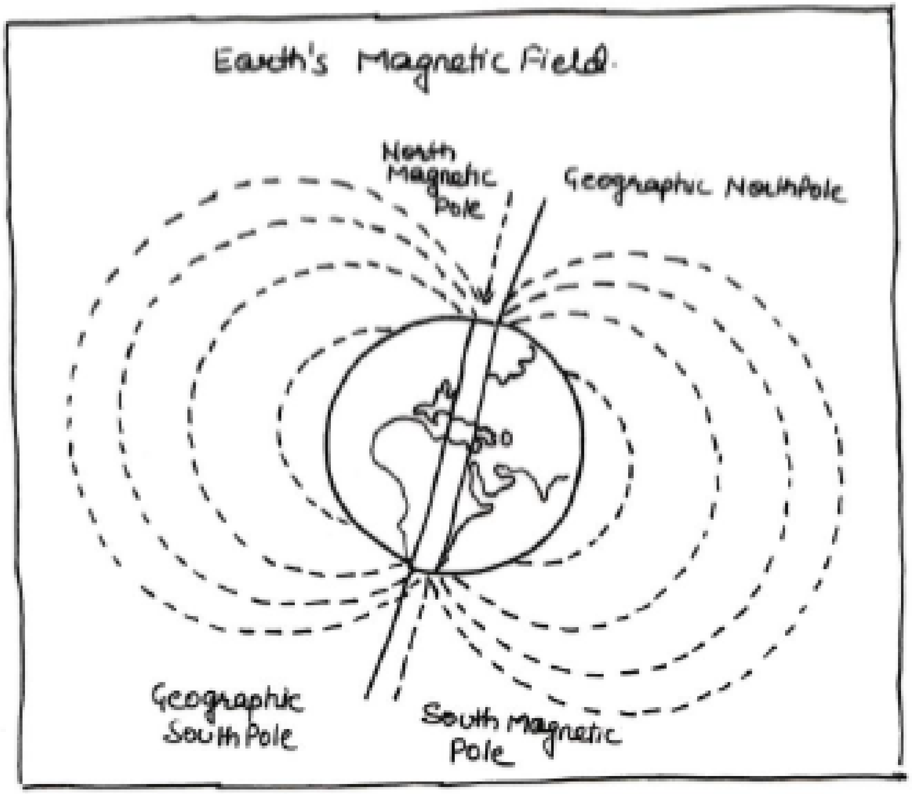
Ques. 1 (a) What are fundamentals of geomagnetism?

Ans. 1 (a) The magnetic properties of the iron-rich mineral magnetite, or lodestone, were known to the Ancient Greeks, but the magnetic compass was not invented until the 13th century when the Chinese floated lodestone on wood and found that it caused the wood to rotate to a fixed position. The use of a compass in navigation and path finding lies in the fact that a magnetized needle that is free to rotate about a vertical axis always comes to rest with one end pointing in the direction of the north magnetic pole. The reason why a compass needle consistently points north-south in this fashion was first explained by the 17th century British physicist William Gilbert, who suggested that the Earth itself acted as a huge magnet, the force of which controlled the orientation of smaller ones.

Although the exact relationship is still a matter of intense debate, scientists now think that this magnetism is related to the motion of a liquid layer deep within the Earth's interior. This layer is rich in iron and spins like a dynamo under the influence of the Earth's rotation. The spinning dynamo, in turn, generates the planet's magnetic field. This field behaves as if a simple bar magnet were aligned north-south at the Earth's center, producing lines of magnetic force which emerge from the southern hemisphere and loop through space to return in the northern hemisphere. Therefore the lines of magnetic force are parallel to the Earth's surface at the equator but plunge ever more steeply as the poles are approached, pointing up out of the ground in the southern hemisphere and down into the ground in the northern hemisphere.



The orientation of a compass needle pivoted on its center of gravity is controlled by these invisible lines of magnetic force. The lines cause the compass needle to point north but also cause the needle to tilt, the north end tilting downward in the northern hemisphere and upward in the southern hemisphere. So a compass reading really has two components - a horizontal component, or swing, used in navigation and path finding; and a vertical component or tilt, known as the magnetic inclination. Because the amount of inclination progressively increases with distance from the equator, and the direction of tilt is different in the northern and southern hemispheres, the inclination of a compass needle can be used to determine latitude.

The study and measurements of the Earth's magnetic field from ancient rocks is called paleo magnetism. When the history of the Earth's magnetic field was first examined in this way, the results were startling. Rather than pointing to the present day magnetic poles as expected, the tiny magnetic compass needles in ancient basalt lavas were found to point in many different directions.

Apparent Polar Wander

When modern basalt lava flows, like those of Hawaii, are examined paleo magnetically, their tiny magnetite compass needles are found to point toward the present day magnetic poles. But this is not the case for ancient basalt lavas. Magnetized rock samples taken from basalts all over North America, for example, were found to point in the same direction providing the basalts were the same age, but the direction was not north-south. Moreover, magnetized samples from basalts of different age were found to point in different directions, suggesting that the Earth's magnetic poles had moved with time. Yet harder to explain, basalts of the same age but from different continents gave different positions for the same magnetic pole. Only the geologically most recent basalts gave calculated "north pole" positions that coincided with the true position of the North Pole. If the continents were fixed, this data suggested that the Earth had several north and south poles at the same time.

In order to obtain a systematic view of these puzzling magnetic patterns, pole positions were calculated for rocks from North America and Europe for the last 300 million years.

The line connecting the changing positions of either pole suggested by successively older basalt samples from a given continent is called a polar wander curve, and traces the pole's apparent movement.

A corresponding analysis of the European data produced similar results. European basalts of the same age define the same "north pole", but basalts of different ages have different "north poles" whose positions can be connected to define a polar wander curve for Europe. However, this pole wander curve has a different path from of North America. If the continents had fixed positions, this would be very difficult to explain.

But the position of the magnetic poles is thought to be geographically fixed by the Earth's axis rotation. If so, how could the poles "wander" or change their positions. They don't wander and there can't be several of them at once. There are only two realistic options. Either the magnetic poles have moved in some unknown manner, or the continents have moved. If the continents moved, the magnetic records frozen into ancient basalts when they erupted on continents millions of years ago would become reoriented by the movement. As the positions of the magnetic poles are constrained by the Earth's rotational axis, it is most unlikely that they have moved to the extent suggested by the data. By eliminating the first option we are left either the second, that is, the movement of the continents. Furthermore, when the continents are reassembled into a Pangea "fit" like the one proposed by Wegner, the two polar wander paths coincide. This suggests that the two continents were once joined and that their polar wander oaths diverged with the opening of the North Atlantic Ocean.

Paleomagnetic Reversals

A key piece of the puzzle was provided by an even more startling paleomagnetic discovery. Magnetized samples of basalts from the same locality were repeatedly found in which the north and south poles had apparently been interchanged. That is, the north magnetic pole suddenly swapped position with the south magnetic pole so that the tiny compass needles produced in basalt lavas erupted at the time pointed south rather than north. To test these rival possibilities, Allan Cox of Standard University and Brent Dallrymple of the U.S Geological Survey set about collecting magnetized samples from all over the world in order to compare their mineral content, their direction of magnetization, and their age. If, they argued, rocks were reversely magnetized because they contained a certain mineral, then all reversely magnetized samples would contain that mineral. If, on the other hand, the Earth's magnetic field had reversed, then samples from all over the world would record the magnetic reversal at precisely the same time. Amazingly, their study showed that it was the Earth's magnetic field that periodically reversed itself during an event known as a magnetic polarity reversal.

Que. 1 (b) Discuss the characteristics of precipitation regimes of world.

Ans. 1 (b) Globally, rain is the main source of fresh water for plants and animals rainfall is essential for life across Earth's landscapes. In addition to moving tremendous amounts of water through Earth's atmosphere, rain clouds also move tremendous amounts of energy. When water evaporates from the surface and rises as vapor into the atmosphere, it carries heat from the sun-warmed surface with it. Later, when the water vapor condenses to form cloud droplets and rain, the heat is released into the atmosphere. **This heating is a major part of Earth's energy budget and climate.**

The most obvious pattern in the total rainfall maps is seasonal change. A band of heavy rain moves north and south of the Equator seasonally. In fact, about two-thirds of all rain falls along or near the equator, and countries in those latitudes often have several months of near-daily rain followed by months of dryness as the rain band moves north and south. The Asian monsoon brings rain to China, Southeast Asia, and India between April and September. From October through May, South America goes through a rainy season, but even parts of the Amazon Rainforest goes a few months each year without significant rain.

The most important geographic aspect of atmospheric moisture is the spatial distribution of precipitation. The broad-scale zonal pattern is based on latitude, but many other factors are involved and the overall pattern is complex. A major cartographic device used on maps that illustrates worldwide. precipitation distribution is the isohyet, a line joining points of equal quantities of precipitation.

Average Annual Precipitation

- The amount of precipitation on any part of Earth's surface is determined by

- the nature of the air mass involved and
- the degree to which that air is uplifted.
- The humidity, temperature, and stability of the air mass are mostly dependent on where the air originated (over land or water, in high or low latitudes) and on the trajectory, it has followed.
- The amount of uplifting, and whether or not that uplifting takes place, are determined largely by zonal pressure patterns, topographic barriers, and storms and other atmospheric disturbances.

The most conspicuous feature of the worldwide annual precipitation pattern is that the tropical latitudes contain most of the wettest areas. The warm trade winds are capable of carrying enormous amounts of moisture, and where they are forced to rise, very heavy rainfall is usually produced. Equatorial regions particularly reflect these conditions, as warm, moist, unstable air is uplifted in the ITC zone, where warm ocean water easily vapourizes. Considerable precipitation also results where trade winds are forced to rise by topographic obstacles. As the trades are easterly winds, it is the eastern coasts of tropical landmasses – for example, the east coast of Central America, northeastern South America, and Madagascar – where this orographic effect is most pronounced. Where the normal trade-wind pattern is modified by monsoons, the onshore trade-wind flow may reverse direction. Thus, the wet areas on the western coast of southeastern Asia, India, and what is called the Guinea Coast of West Africa are caused by the onshore flow of southwesterly winds that are nothing more than trade winds diverted from a 'normal' pattern by the South Asian and West African monsoons.

The only other regions of high annual precipitation shown on the world map are narrow zones along the western coasts of North and South America between 40° and 60° of latitude. These areas reflect a combination of frequent onshore westerly airflow, considerable storminess, and mountain barriers running perpendicular to the direction of the prevailing westerly winds. The presence of these north-south mountain ranges near the coast restricts the precipitation to a relatively small area and creates a pronounced rain shadow effect to the east of the ranges.

The principal regions of sparse annual precipitation on the world map are found in three types of locations:

1. Dry lands are most prominent on the western sides of continents in subtropical latitudes (centered at 25° or 30°). High-pressure conditions dominate at these latitudes, particularly on the western sides of continents, which are closer to the normal positions of the subtropical high-pressure cells. High pressure means sinking air, which is not conducive to condensation and precipitation. These dry zones are most extensive in North Africa and Australia, primarily because of the blocking effect of landmasses or highlands to the east. (The presence of such landmasses prevents moisture from coming in from that direction).
2. Dry regions in the midlatitudes are most extensive in central and southwestern Asia, but they also occur in western North America and southeastern South America. In each case, the dryness is due to lack of access for moist air masses. In the Asian situation, this lack of access is essentially a function

of distance from any ocean where onshore airflow might occur. In North and South America, there are rain shadow situations in regions of predominantly westerly airflow.

3. In the high latitudes, there is not much precipitation anywhere. Water surfaces are scarce and cold, and so little opportunity exists for moisture to evaporate into the air. As a result, polar air masses have absolute humidities and precipitation is slight. These regions are referred to accurately as 'cold deserts'.
4. One further generalization on precipitation distribution is the contrast between continental margins and interiors. Because coastal regions are much closer to moisture sources, they usually receive more precipitation than interior regions.

Seasonal Precipitation Patterns

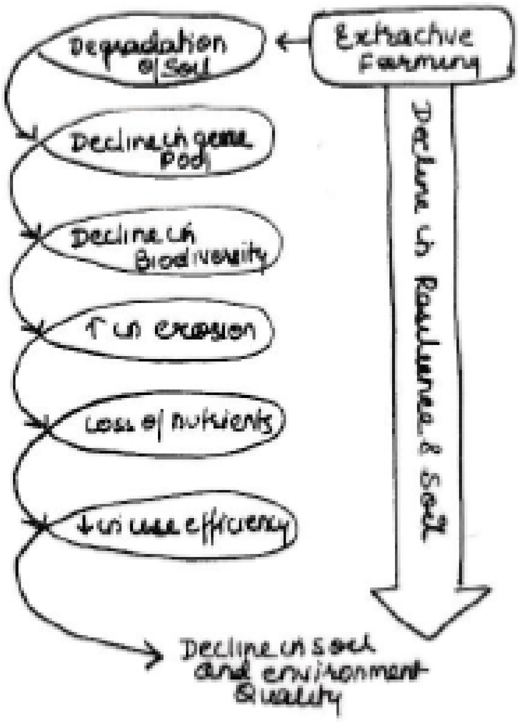
A geographic understanding of climate requires knowledge of seasonal as well as annual precipitation patterns. Over most of the globe, the amount of precipitation received in summer is considerably different from the amount received in winter. This variation is most pronounced over continental interiors, where strong summer heating at the surface induces greater instability and the potential for greater convective activity. Thus in interior areas most of the year's precipitation occurs during summer months, and winter is generally a time of anticyclonic conditions with diverging airflow.

Que. 1 (c) Avail brief details of challenges faced by soil.

Ans. 1(c) Soil degradation implies a decline in soil quality with an attendant reduction in ecosystem functions and services. Conceptually, there are **four types of soil degradation**:

(i) physical; (ii) chemical; (iii) biological; and (iv) ecological

Soil physical degradation generally results in a reduction in structural attributes including pore geometry and continuity, thus aggravating a soil's susceptibility to crusting, compaction, reduced water infiltration, increased surface runoff, wind and water erosion, greater soil temperature fluctuations, and an increased propensity for desertification. Soil chemical degradation is characterized by acidification, salinization, nutrient depletion, reduced cat ion exchange capacity (CEC), increased Al or Mn toxicities, Ca or Mg deficiencies, leaching of NO3-N or other essential plant nutrients, or contamination by industrial wastes or by-products. Soil biological degradation reflects depletion of the soil organic carbon (SOC) pool, loss in soil biodiversity, a reduction in soil C sink capacity, and increased greenhouse gas (GHG) emissions from soil into the atmosphere. One of the most severe consequences of soil biological degradation is that soil becomes a net source of GHG emissions (i.e., CO2 and CH4) rather than a sink. Ecological degradation reflects a combination of other three, and leads to disruption in ecosystem functions such as

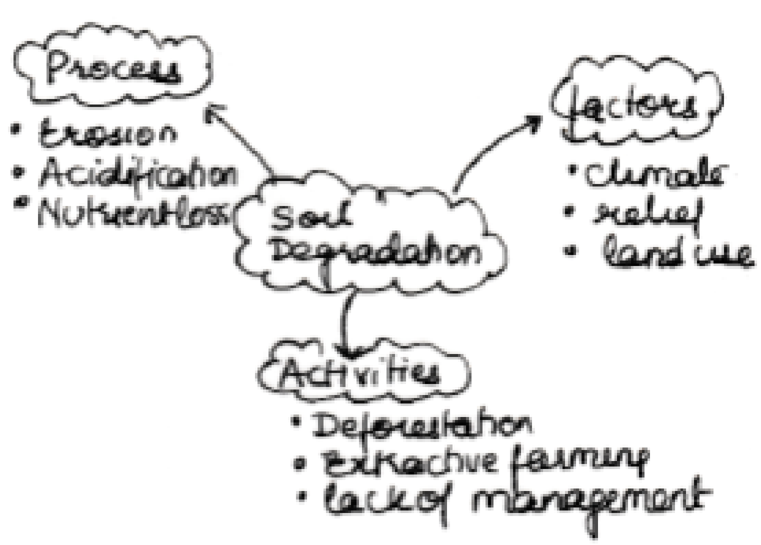


elemental cycling, water infiltration and purification, perturbations of the hydrological cycle, and a decline in net biome productivity. The overall decline in soil quality, both by natural and anthropogenic factors, has strong positive feedbacks leading to a decline in ecosystem services and reduction in nature conservancy. Once the process of soil degradation is set-in-motion, often by land misuse and soil mismanagement along with the extractive farming, it feeds on itself in an ever-increasing downward spiral.

Soil and Ecosystem Services

Soil, the most basic of all resources, is the essence of all terrestrial life and a cultural heritage. Yet, soil is finite in extent, prone to degradation by natural and anthropogenic factors, and is non-renewable over the human timescale (decades). Soil quality also has strong implications to human health.

Soil organisms are sensitive to changes in land use, climate, and natural disturbance. Human soil disturbances like mining, road and building construction, tillage for agriculture, erosion, and land degradation are major threats to soil biodiversity, particularly impacting fungi and soil invertebrates. In many cases, these changes lead in irrevocable changes in soil biodiversity and soil functioning. In addition, invasive species, including invasive soil organisms, can decrease biodiversity and alter decomposition and nutrient cycling rates. Increased wildfire intensity can directly impact soil organisms, alter plant inputs, and change water infiltration capacity. Climate change may shift soil communities, and also changes how quickly soil communities decompose plant material and soil organic matter. People rely on soil for food, clean water, flood and drought mediation, and climate regulation. As we recognize both our reliance on ecosystems and our ability to alter them, it is important to understand how we negatively impact soil organisms that support us, and how we can change behavior to protect soil biodiversity and sustain our future.



Soil Organic Carbon and Its Impact on Soil Quality

The SOC pool, including its quantity and quality, is the defining constituent of soil . Indeed, SOC pool is the most reliable indicator of monitoring soil degradation, especially that caused by accelerated erosion . Soil degradation depletes the SOC pool, along with it, plant available N and other essential nutrients such as P and S. Furthermore, as identified repeatedly in this special issue of Sustainability, depletion of SOC pool is a global issue and a principal cause of soil degradation, especially in the European semi-arid Mediterranean regions.

Soil Quality Index

The SOC pool is a key indicator of soil quality, and an important driver of agricultural sustainability. In addition to its amount, other parameters of SOC include its depth distribution, quality or attributes (physical, chemical, biological).

Conservation Agriculture and Soil Quality

Four basic principles of CA are : (i) retention of crop residue mulch; (ii) incorporation of a cover crop in the rotation cycle; (iii) use of combination of chemical and bio fertilizers; and (iv) elimination of soil mechanical disturbances. Properly implemented on suitable soil types, CA has numerous co-benefits including reduced fuel consumption and increased soil C sequestration. Mechanical tillage is an energy-intensive process and its reduction or elimination can decrease consumption of fossil fuels.

Que.1 (d) Avail detailed account on global attempts to abate marine pollution.

Ans. 1(d) Ocean pollution — also called marine pollution — is a mixture of both chemical contamination and trash. The act of ocean pollution occurs when chemicals and trash are either washed, blown or intentionally dumped into the ocean. There are many causes of ocean pollution, but most (80%) of the pollution in our oceans originates on land and is caused by humans. Here are some of the major causes of marine pollution:

Nonpoint source pollution (runoff)

Nonpoint source pollution is the accumulation of pollution from small sources that can't be exactly pinpointed. Examples include the pollution created by individual cars, boats, farms and construction sites. Nonpoint source pollution typically becomes ocean pollution via runoff, which occurs when rain or snow moves pollutants from the ground into the ocean. For instance, after a heavy rainstorm, water flows off roads into the ocean, taking oil left on streets from cars with it. But wind can transfer dirt and other debris from nonpoint sources and deposit these pollutants on the ocean's surface.

Point source pollution discharge

Manufacturing plants in many areas of the world release toxic waste into the ocean, including mercury. While it has been banned in the USA, sewage also contributes to ocean pollution. Meanwhile, plastic waste poses a particularly tough challenge; according to the Ocean Conservancy, eight million metric tons of plastic go into our oceans every year.

Oil spills Ships are major contributors to ocean pollution, especially when crude oil spills occur. Crude oil lasts for years in the ocean and is difficult to clean up. You can find a history of oil spills on the NOAA site, but the largest one in recent history was, by far, the 2010 Deepwater Horizon well blowout in the Gulf of Mexico, which spilled roughly 134 million gallons of oil into the ocean.

Littering Atmospheric pollution — a type of ocean pollution where objects are carried by the wind to the ocean — is often caused by littering. It includes single-use plastics (such as plastic bags) and styrofoam containers which can take hundreds of years to biodegrade. It is estimated that roughly 1 trillion plastic bags are used worldwide per year.

Ocean mining Deep-sea ocean mining causes ocean pollution and ecosystem disruption at the lowest levels of the ocean. Drilling for substances such as cobalt, zinc, silver, gold and copper creates harmful sulfide deposits deep in the ocean.

Ocean Noise The ocean is far from a "silent world." Sound waves travel farther and faster in the sea's dark depths than they do in the air, and many marine mammals like whales and dolphins, in addition to fish and other sea creatures, rely on communication by sound to find food, mate, and navigate. But an increasing barrage of human-generated ocean noise pollution is altering the underwater acoustic landscape, harming—and even killing—marine species worldwide.

Offshore Drilling In addition to noise pollution, the oil and gas industry's routine operations emit toxic by-products, release high levels of greenhouse gases, and lead to thousands of spills.

Effects of ocean pollution

Ocean pollution has many consequences that directly and indirectly affect marine life, as well as humans. Here are some of the most common effects of ocean pollution:

Harmful to marine species Sea animals are frequent victims of ocean pollution. Oil spills, for instance, will ensnare and suffocate marine animals by permeating their gills. When the oil gets into seabird feathers, they may not be able to fly or feed their young. Animals that aren't killed by crude oil may suffer from cancer, behavioral changes and become unable to reproduce. Marine animals also mistake small plastic debris for food or become entangled in or strangled by plastic bags and discarded fishing nets. Animals most vulnerable to harm from plastic debris in the ocean include dolphins, fish, sharks, turtles, seabirds and crabs.

Depletion of oxygen in seawater As excess debris in the ocean slowly degrades over many years, it uses oxygen to do so, resulting in less oxygen in the ocean. Low levels of oxygen in the ocean lead to the death of ocean animals such as penguins, dolphins, whales and sharks. Excess nitrogen and phosphorus in seawater also cause oxygen depletion. When a great deal of oxygen depletion occurs in an area of the ocean, it can become a dead zone (see below) where very little marine life can survive.

A threat to human health Pollutants in the ocean make their way back to humans. Small organisms ingest toxins and are eaten by larger predators, many of which are seafood that we eventually eat. When the toxins in contaminated animals get deposited in human tissue, it can lead to long-term health conditions, cancer and birth defects. For example, phytoplankton will absorb methylmercury (bacteria-converted mercury carried down to the ocean's surface). This makes its way up the food chain when zooplankton eat the phytoplankton, then small fish eat the zooplankton, then bigger fish eat the smaller fish. By the time you reach a fish the size of a swordfish, they can contain a very high mercury load (in fact, swordfish contain one of the highest mercury loads).

While the exact amount of pollution in the ocean is difficult to measure, one recent study estimates that the world's oceans are polluted by roughly 171 trillion plastic particles that, if gathered, would weigh roughly 2.3 million tons. These microplastics (tiny plastic particles .2 inches or smaller) find their way into marine ecosystems and our water.

The Great Pacific Garbage Patch is a collection of litter — primarily microplastics — in the North Pacific Ocean, and is actually composed of two separate large patches, the Western Garbage Patch (found near Japan) and the Eastern Garbage Patch (found between Hawaii and California). The GPGP is the biggest, but not the only, garbage patch; the Atlantic and Indian Oceans are home to trash vortexes, and smaller bodies of water are also developing them.

Dead zones are areas of water where sea life cannot survive due to reduced oxygen levels. Dead zones result from nutrient pollution — a type of pollution created when runoff introduces excess nutrients like nitrogen and phosphorus — which encourages the growth of algae blooms. These algae blooms consume oxygen and block sunlight to oxygen-producing underwater plants.

Marine Pollution abatement efforts

London Convention on Marine Pollution

The London Convention or LC-72 is a non-binding treaty which seeks address the problem of deliberate disposal at sea of wastes or other matter from vessels, aircraft, and platforms. But it does not cover discharges from land-based sources such as pipes and outfalls, wastes generated incidental to normal operation of vessels, or placement of materials for purposes other than mere disposal, providing such disposal is not contrary to aims of the Convention.

One regional type of convention is Barcelona Convention, which covers the same problems in the Mediterranean Sea.

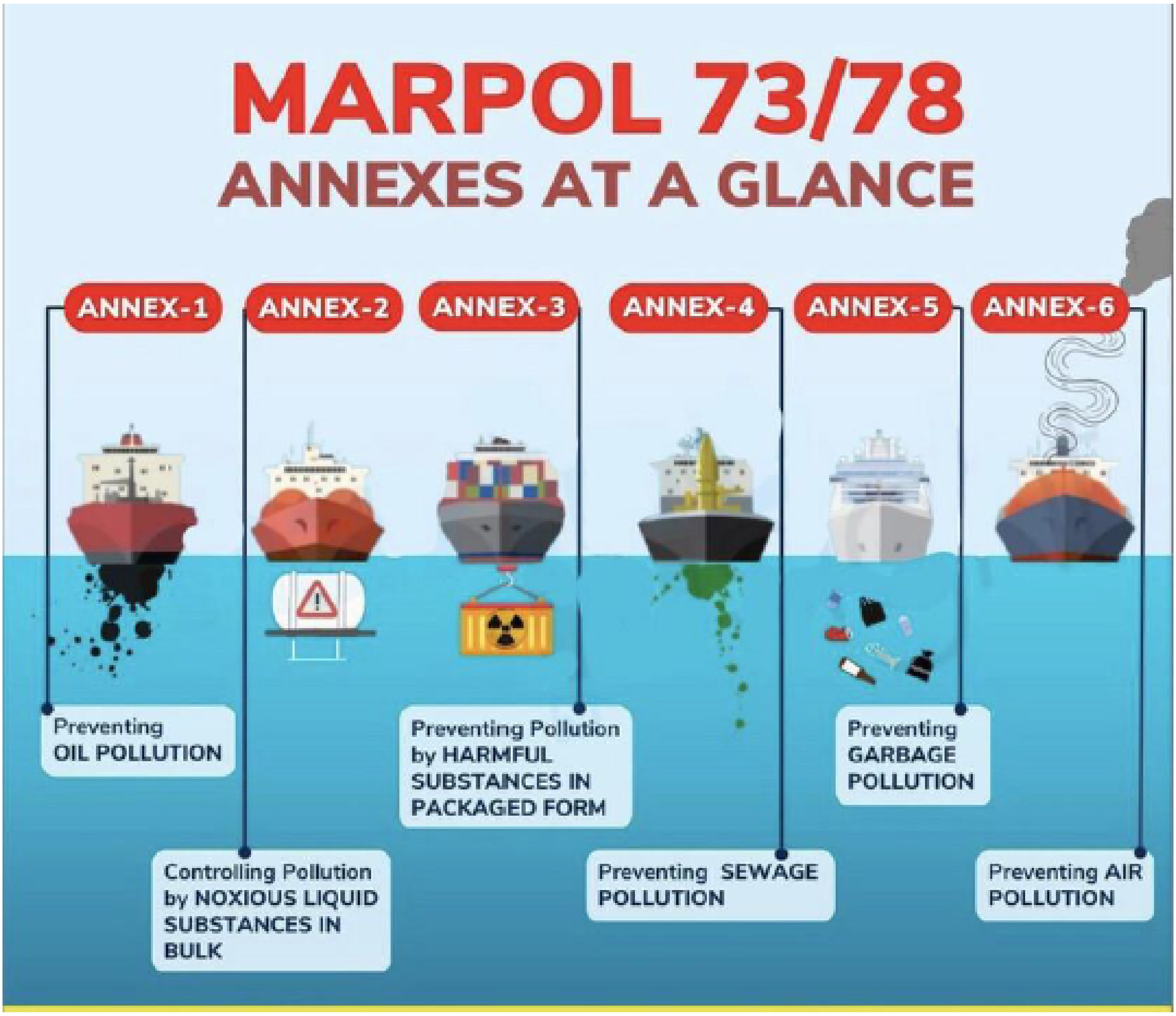
International Convention for the Regulation of Whaling

International Convention for the Regulation of Whaling is an international environmental agreement which governs the commercial, scientific, and aboriginal subsistence whaling practices of fifty-nine member nations. It was signed in 1946. By this convention, International Whaling Commission (IWC) was set up to "provide for the proper conservation of whale stocks and thus make possible the orderly development of the whaling industry".

This organization has been active against the commercial whaling. In 1986, it adopted a moratorium on commercial whaling. This ban still continues. In 1994, it created the Southern Ocean Whale Sanctuary surrounding the continent of Antarctica. Here, the IWC has banned all types of commercial whaling. Only two such sanctuaries have been designated by IWC till date. Another is Indian Ocean Whale Sanctuary by the tiny island nation of the Seychelles.

MARPOL 73/78

MARPOL refers to Marine Pollution. MARPOL 73/78 is the International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. It entered into force on 2 October 1983 and it has 169 parties. It is one of the most important environment conventions on marine pollution and prevents the pollution from Oil Spill, Noxious Liquid Substances carried in Bulk, Harmful Substances carried in Packaged Form, Sewage , Garbage and Air Pollution.



It centers around minimizing the pollution of the seas, including dumping, oil and exhaust pollution. There are 150 countries party to this agreement.

India is a party to MARPOL 73/78. India's enshrined the obligation to inform contravention of provision of MARPOL 73/78 of Merchant Shipping Act 1948