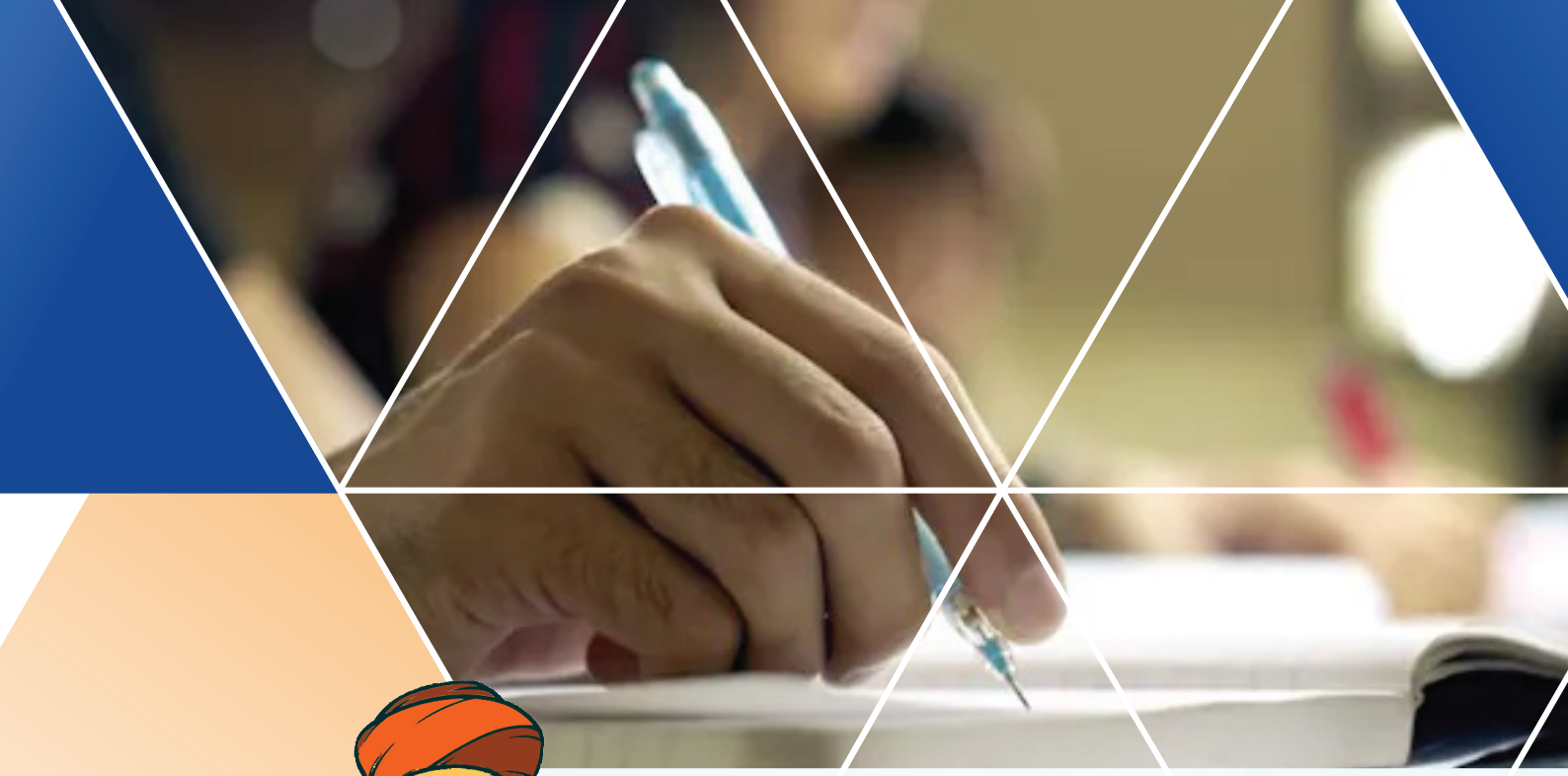


IAS BABA

TLP 2022

Phase 2 - Compilation

Part 2

GS 1

1. With the help of suitable examples, explain the significance of volcanism for the development of landforms.

Approach

Candidates can start with giving basic information on volcanism and then explain the relevance of different volcanoes form in landform formation with giving examples.

Introduction

A volcano is a rupture in the crust of a planetary-mass object, such as Earth, that allows hot lava, volcanic ash, and gases to escape from a magma chamber below the surface. The process is called Volcanism and has been ongoing on Earth since the initial stages of its evolution over 4 billion years ago.

Body

- On Earth, volcanism happens in many different geologic settings. Most of these are associated with the boundaries of the enormous rigid plates that make up the crust and upper mantle.
- Volcanic landforms are divided into extrusive and intrusive landforms based on weather magma cools within the crust or above the crust. Rocks formed by either plutonic (cooling of magma within the crust) or volcanic (cooling of lava above the surface) are called 'Igneous rocks'.

Significance of volcanism for development of landforms:

- Volcanism creates new fertile landforms like islands, plateaus, volcanic mountains etc. E.g. Deccan traps.
- The volcanic ash and dust are very fertile for farms and orchards.
- Volcanic rocks yield very fertile soil upon weathering and decomposition.
- Mineral resources, particularly metallic ores are brought to the surface by volcanoes. Sometimes copper and other ores fill the gas-bubble cavities.
- The famed Kimberlite rock of South Africa, the source of diamonds, is the pipe of an ancient volcano.
- In the vicinity of active volcanoes, waters in depth are heated from contact with hot magma giving rise to springs and geysers.

Lava Plains and Basalt Plateaus:

- Sometimes, a very thin magma escapes through cracks and fissures in the earth's surface and flows after intervals for a long time, spreading over a vast area, finally producing a layered, undulating (wave like), flat surface.
- Example: Deccan traps (peninsular India), Snake Basin, U.S.A, Icelandic Shield, Canadian Shield etc.

Mid-Ocean Ridges:

- 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.
- The lava is basaltic in nature. It Cools slowly and flows through longer distances.
- The lava here is responsible for sea floor spreading. Example: Mid-Atlantic Ocean ridge; extension is seen in the Iceland.

Calderas:

- After the eruption of magma has ceased from the cones, the crater frequently turns into a lake at a later time.
- Water may collect in the crater. This lake is called a 'caldera'.
- Example: Lake Toba in Sumatra, Crater Lake in Oregon, USA.

Shield Volcanoes or Lava domes:

- These volcanoes are mostly made up of basalt, a type of lava that is very fluid when erupted. They are not steep.
- They become explosive if somehow water gets into the vent; otherwise, they are less explosive.
- Example: Mauna Loa (Hawaii).

Composite Cones or Strato volcanoes:

- They are conical or central type volcanic landforms.
- Along with andesitic lava, large quantities of pyroclastic material and ashes find their way to the ground.
- They are accumulated in the vicinity of the vent openings leading to formation of layers, and this makes the mounts appear as composite volcanoes.
- Example: Vesuvius, Mt. Fuji, Stromboli (Lighthouse of the Mediterranean) etc.

Intrusive landforms are formed when magma cools within the crust. The intrusive activity of volcanoes gives rise to various forms:

Batholiths

- These are huge mass of igneous rocks, usually of granite.
- These rock masses formed due to cooling down and solidification of hot magma inside the earth.
- They appear on the surface only after the denudation processes remove the overlying materials and may be exposed on surface after erosion.
- Example: Wicklow mountains of Ireland; the uplands of Brittany, France.

Laccoliths

- These are large dome-shaped intrusive bodies connected by a pipe-like conduit from below.
- These are basically intrusive counterparts of an exposed domelike batholith.
- Example: The laccoliths of Henry mountains in the Utah, USA.

Conclusion

Volcanism helps in the formation of various landforms on the earth's surface and bears both positive and negative effects on the climate, environment and human life. With scientific studies, one can predict the volcanic eruption to much extent. Preparedness for this natural disaster can protect human life and environment to a larger extent.

2. What are faults? How do they cause earthquakes? Provide an overview of the distribution of earthquake-prone areas caused by movement of plates along faults.

Approach

Question is straight forward. Candidate can define faults and their role in earthquakes. With the help of a diagram, distribution of earthquake prone areas along plates can be given.

Introduction

A fault is a fracture or zone of fractures between two blocks of rock. Faults allow the blocks to move relative to each other. This movement may occur rapidly, in the form of an earthquake - or may occur slowly, in the form of creep. Faults may range in length from a few millimeters to thousands of kilometers. Most faults produce repeated displacements over geologic time.

Body

How faults cause earthquakes?

- An earthquake is shaking or trembling of the earth's surface, caused by the seismic waves or earthquake waves that are generated due to a sudden movement (sudden release of energy) in the earth's crust (shallow-focus earthquakes) or upper mantle (some shallow-focus and all intermediate and deep-focus earthquakes).
- The immediate cause of most shallow earthquakes is the sudden release of stress along a fault rupture (crack) in the earth's crust.
- Sudden slipping of rock formations along fault rupture in the earth's crust happens due to the constant change in volume and density of rocks due to intense temperature and pressure in the earth's interior.

- The longer the length and the wider the width of the faulted area, the larger the resulting magnitude.
- The longest earthquake ruptures along thrust faults (convergent boundary) are approximately 1,000 km.
- The longest earthquake ruptures on strike-slip faults (transform fault) are about half to one third as long as the lengths along the thrust fault. The fault ruptures along normal faults (divergent boundary) are shorter.
- Slipping of land along the faultline along convergent, divergent and transform boundaries cause earthquakes.
- Reverse faults (convergent boundary) are associated with the most powerful earthquakes, megathrust earthquakes, including almost all of those of magnitude 8 or more.
- Megathrust earthquakes occur at subduction zones, where one tectonic plate is forced underneath another. E.g. 2004 Indian Ocean earthquake.
- Strike-slip faults, particularly continental transforms, can produce major earthquakes up to about magnitude 8.
- San Andreas Fault is a transform fault where Pacific plate and North American plate move horizontally relative to each other causing earthquakes along the fault lines.
- Earthquakes associated with normal faults (divergent boundary) are generally less than magnitude 7.

Distribution of earthquake prone areas

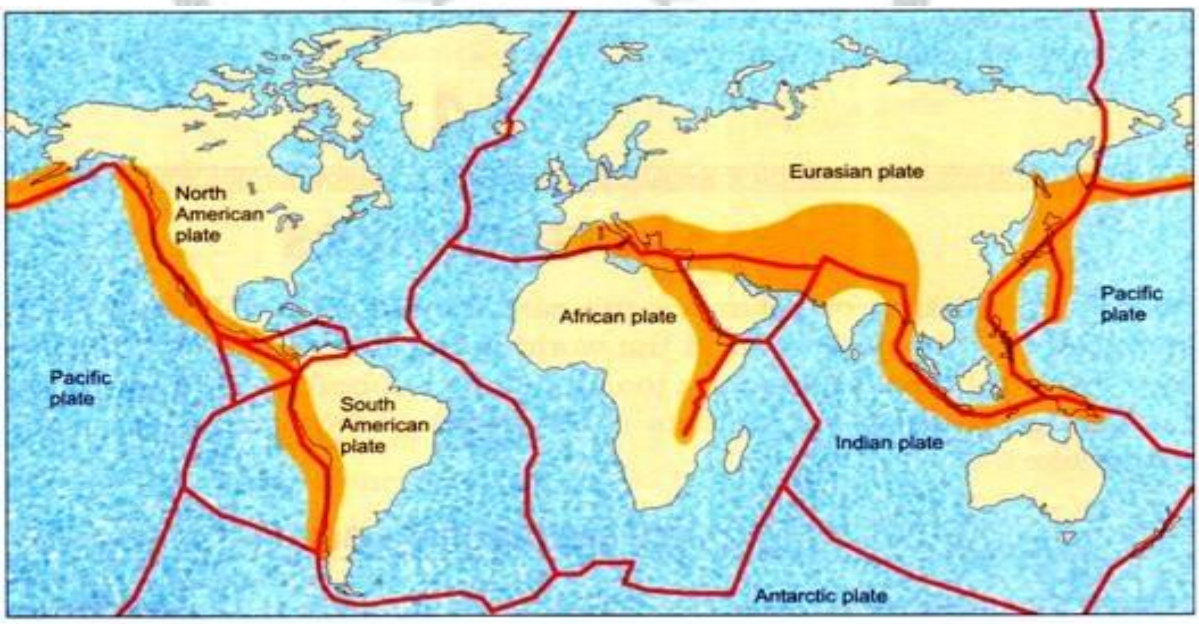


Fig. 14.3 The earthquake-prone zones (shaded) are along the boundaries of the tectonic plates.

- The world's greatest earthquake belt, the circum-Pacific seismic belt, is found along the rim of the Pacific Ocean, where about 81 percent of our planet's largest earthquakes occur. It has earned the nickname "Ring of Fire".

- The belt exists along boundaries of tectonic plates, where plates of mostly oceanic crust are sinking (or subducting) beneath another plate. Earthquakes in these subduction zones are caused by slip between plates and rupture within plates.
- The Alpide earthquake belt (mid Continental belt) extends from Java to Sumatra through the Himalayas, the Mediterranean, and out into the Atlantic.
- This belt accounts for about 17 percent of the world's largest earthquakes, including some of the most destructive.
- The third prominent belt follows the submerged mid-Atlantic Ridge. The ridge marks where two tectonic plates are spreading apart (a divergent plate boundary).
- Most of the mid-Atlantic Ridge is deep underwater and far from human development.

Conclusion

Earthquakes are a natural hazard. If a tremor of high magnitude takes place, it can cause heavy damage to the life and property of people. India is one of the highly earthquake affected countries because of the presence of technically active young fold mountains - Himalaya.

3. What are auroral displays? What causes them? explain.

Approach

A simple straightforward question where candidates need to explain what are auroral displays? In second part of answer write about what causes auroral displays. explain in detail.

Introduction

An aurora is a natural phenomenon which is characterised by a display of a natural-coloured (green, red, yellow or white) light in the sky. It is a light show which is caused when electrically-charged particles from the sun collide with particles from gases such as oxygen and nitrogen present in the Earth's atmosphere.

Body

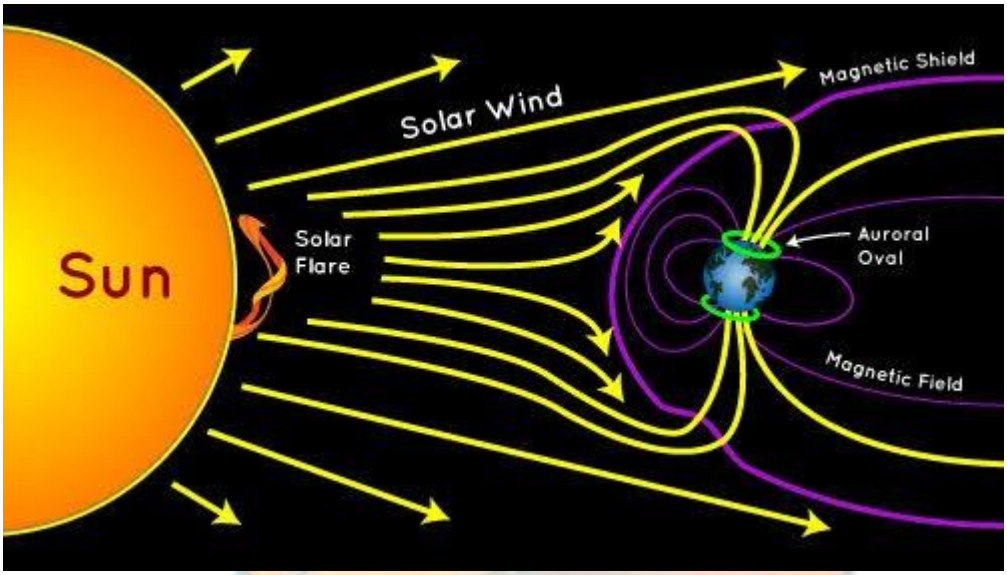
An Aurora is a display of light in the sky predominantly seen in the high latitude regions (Arctic and Antarctic). It is also known as a Polar light. They commonly occur at high northern and southern latitudes, less frequent at mid-latitudes, and seldom seen near the equator.

- They commonly occur at high northern and southern latitudes, less frequent at mid-latitudes, and seldom seen near the equator.

- While usually a milky greenish color, auroras can also show red, blue, violet, pink, and white. These colors appear in a variety of continuously changing shapes.

Science behind their occurrence:

- Auroras are a spectacular sign that our planet is electrically connected to the Sun. These light shows are provoked by energy from the Sun and fueled by electrically charged particles trapped in Earth's magnetic field.
- The typical aurora is caused by collisions between fast-moving electrons from space with the oxygen and nitrogen in Earth's upper atmosphere.
- The electrons—which come from the Earth's magnetosphere, the region of space controlled by Earth's magnetic field —transfer their energy to the oxygen and nitrogen atoms and molecules, making them "excited".
- As the gases return to their normal state, they emit photons, small bursts of energy in the form of light.
- When a large number of electrons come from the magnetosphere to bombard the atmosphere, the oxygen and nitrogen can emit enough light for the eye to detect, giving us beautiful auroral displays.
- An aurora is caused by the streams of electrified particles (which are emitted by the sun) trapped in the magnetic field of the earth.
- It is produced when this magnetosphere is disturbed by the solar wind carrying the charged particles. Auroras are seen in latitudes of around 70 degrees. They generally occur in a band known as 'auroral zone'. The auroral zone is 3 to 6 degrees wide in latitude.
- It lies between 10 and 20 degrees from the geomagnetic poles. This is visible quite clearly during the night. Auroras can sometimes be seen at latitudes below the actual auroral zone.
- Auroras can appear in various forms like streamers, patches, arcs, scattered light, diffused light etc.
- The brightest and the most distinctive of all forms of auroras are the ones which are curtain-like in the shape of an arc, extending in the east-west direction. This natural light effect is known as 'aurora borealis' in northern altitudes, while the effect in the southern latitudes is known as 'aurora australis'.
- (Auroras that occur in Northern hemisphere are known as aurora borealis and auroras that take place in Southern hemisphere are known as aurora australis.) Aurora borealis is also known as 'Northern lights'. Similarly, aurora australis is also known as 'Southern lights'.
- They origin at altitudes of 100 to more than 400 km.



Why do auroras come in different colors and shapes?

- The color of the aurora depends on which gas — oxygen or nitrogen — is being excited by the electrons, and on how excited it becomes. The color also depends upon how fast the electrons are moving, or how much energy they have at the time of their collisions.
- High energy electrons cause oxygen to emit green light (the most familiar color of the aurora), while low energy electrons cause a red light. Nitrogen generally gives off a blue light.
- The blending of these colors can also lead to purples, pinks, and whites. The oxygen and nitrogen also emit ultraviolet light, which can be detected by special cameras on satellites.

Effects:

- Auroras affect communication lines, radio lines and power lines.
- It should also be noted here that Sun's energy, in the form of solar wind, is behind the whole process.

Conclusion

Aurora borealis is frequently visible in Northern Scandinavia in a band that stretches between 66°N and 69°N, which we call the Aurora Zone. The band can expand when geomagnetic activity is high. The aurora borealis is visible from being close to the centre of the Arctic Circle, such as Alaska, Canada, Iceland, Greenland, Norway, Sweden, Finland and Russia. A geomagnetic storm can cause the auroral ovals (north and south) to expand, bringing the aurora to lower latitudes Svalbard, Norway Kakslauttanen, Finland, Jukkasjärvi, Sweden, Reykjavik, Iceland, St. Petersburg, Russia Northern Canada, Scotland, United Kingdom are some of the most iconic places to explore aurora borealis.

4. Some places on earth are highly prone to snowstorms and blizzards. Why? Explain with the help of suitable examples.

Approach

Candidates are expected to write about snowstorms and blizzards and can explain basic difference. Then simply highlight why it occurs in few location frequently with giving examples and explaining its effects.

Introduction-

A blizzard is a severe snowstorm with strong and powerful winds in excess of 35 mph for more than 3 hours and visibility of less than a 1/4 mile. During a blizzard, the temperature is often below 0 degrees, because of this frostbite and hypothermia are common.

Body

Origination of blizzards-snowstorm:

- Cold air (below freezing): In order for there to be snowfall, the air temperature both up in the clouds and down at ground level must be cold. If the air temperature is warm near the ground, the snow will melt before the reaches the ground causing rain instead.
- Moisture: This is known as water vapour. An excellent source of water vapour is when the air must blow across a large body of water, such as the ocean. As the airs blows over the water, some water is evaporated into the air. This is water vapour.
- Warm, rising air: Warm air must rise over cold air in order for a blizzard to form. This can happen in two ways. The wind can pull warm air from the equator towards the poles, and cold air from the poles towards the equator. When warm and cold air meet, a front is formed which results in precipitation. If warm air rises up a mountaintop it can cool as it rises, forming clouds and blizzard snows.

Occurrence of blizzards-snowstorm:

- It is possible for blizzards to occur in conditions of clear skies when no snow is falling if conditions are conducive to the movement of existing surface snow, called ground blizzards.
- In many storms in continental interiors, it is not uncommon for little new snow to be associated with a blizzard, due to a lack of moisture associated with Arctic and Antarctic air masses in winter. In such circumstances, blizzard conditions are largely the result of winds blowing the existing snow cover.
- However, blizzards in some regions (for example, those in Western Europe and the Asian coast of the North Pacific, and "nor'easters" in the northeastern United States) are characteristically accompanied by heavy snowfall.

- Blizzards are produced by strong winds: katabatic winds and those generated by steep sea-level pressure gradients associated with storms in high and mid-latitudes latitudes during winter. A single storm can occur over large areas of a continent and a severe blizzard may persist for a week or more.
- A blizzard that struck Saskatchewan, Canada, in 1947 lasted 10 days, burying a train in a snowdrift a kilometer long. The most severe blizzards occur in Antarctica, with winds exceeding 93.2 mi. (150 km.)/hour; at some Antarctic stations blizzard conditions occur on over half the days annually.
- The blizzard hit south and central China between January 25th and February 6th in 2008 and led to the deaths of at least 129 people. The blizzard coincided with a period when the country experienced its worst winter in more than 20 years when snow was reported in some desert areas including the Taklamakan.
- Meteorologists stated that the freezing winter was caused by La Nina weather phenomena and was not in any way attributed to the effects of global warming. China had to carry a heavy financial burden to alleviate its people from the effects of the blizzard which had not only destroyed millions of crops and livestock but had also extensively damaged the country's electricity grid.
- In February 2018, Russia experienced one of the worst winters in the nation's history. Known as the 'Blizzard of the Century,' the winter brought with it storms which deposited dozens of inches of snow in the country.
- Moscow was thought to have been under 22 inches of snow according to information from the meteorological office. The recent blizzard shows how prone Russia is to blizzards. The country even has a term for this weather phenomenon, 'purgas.'

Effects of Blizzards and snowstorms:

- A blizzard has the ability to put a city into standby, sometimes even for days. It can make driving conditions impossible and results in kids not being able to get to school as well as adults not being able to get to work. This in turn means school and businesses close and people are housebound.
- Low air pressure during a blizzard can make breathing difficult for some people.
- Electrical wires can be damaged resulting in a loss of electricity to homes. People are left without the use of computers, TV's, appliances, and lights.
- Blizzards are life threatening and people have lost their lives because of them.
- Blizzards hurt the economy as businesses lose money when people can't get to work.
- When transport routes and shops close during a blizzard there is a chance of food and water scarcity if the blizzard lasts for an extended period of time.

Conclusion

Under the effects of climate change, mountainous regions across globe are undergoing fast and well-perceptible evolutions, which are attracting the growing attention of people, scientists and managers. To cope better with the hazards and vulnerabilities specific targets and long term plans are must.

5. Distinguish between tornadoes and hurricanes. What makes tornadoes so destructive sometimes? Explain.

Approach

Question is straight forward. Candidate, while defining hurricanes and tornadoes can draw out differences in the same. In the second part, impact of tornadoes and destruction level can be stated.

Introduction

Hurricanes and tornadoes are alike in basic ways. Both produce powerful, swirling winds — and both can leave a path of death and destruction. But hurricanes and tornadoes also differ in crucial ways, including their size and duration as well as how, when and where they form.

Body

- Hurricanes and tornadoes are extreme weather events caused due to the creation of extreme low-pressure regions and strong winds circulated because of pressure gradient created.
- Both the weather events are spins like a top around a fixed point in the center. Both are storms with strong winds that swirl around and around and are very destructive. Though, both are very similar, there are certain features differentiating both.

Difference between hurricanes and tornadoes

Hurricanes	**Tornadoes**
• Hurricanes originates over moisture rich region typically over pacific-ocean. It starts as a wave of low-pressure air and derives its energy from the warm ocean waters. • The strongest hurricanes rarely produce wind speeds around 100 mph. • Hurricanes are much larger, ranging from about 160 km to 1600 km wide. • A hurricane's life cycle can last from days to weeks. • The impact of hurricane is more seen in the coastal regions	• Tornadoes on the other hand called as twisters form over land which produce powerful updrafts of wind that twist as they rise. • Speed: the strongest tornadoes can have wind speeds over 200 mph • The largest tornado every observed was 4 km wide, but most tornadoes are about 0.8 km wide. • A tornado's lifetime is short, ranging from a few seconds to a few hours.

	• tornadoes impact is majorly seen in hinterland.

Why tornadoes are destructive?

- A tornado is a rotating column of air ranging in width from a few yards to more than a mile and whirling at destructively high speeds, usually accompanied by a funnel-shaped downward extension of a cumulonimbus cloud. Winds 40-300+ mph.
- Tornado formation typically needs the four ingredients: shear, lift, instability, and moisture.
- Wind shear is the most important factor that plays into the creation of tornadoes. When there is wind shear, sometimes these winds begin to roll into a horizontal column of air.
- Once you get a strong updraft of air being transported from the ground to the atmosphere, that column of air becomes vertical. That is when a storm usually develops in this scenario.
- Speed of tornadoes are typically high than hurricanes around 400-500mph.
- As tornadoes originate and propagate over land, the destruction level on ground is high.
- As the size of tornado is small, the destruction intensity is higher.

Conclusion

Very often, Hurricanes after making a landfall spawn tornado. The changing climate is believed to be resulting in more frequent and more destructive and is a cause of concern. United States has the most violent tornadoes. At any moment there are approximately 1,800 thunderstorms in progress throughout the world.

1. Discuss the factors responsible for the distributional pattern of the cotton and textile industry in India. Do you observe any changes therein? Examine.

Approach

Candidates can start with giving basic information on Indian cotton and textile industry. And then highlight the factors responsible for determining the location of cotton and industry try to examine the changing dynamics of location factors pre and post-independence and in newly globalized market.

Introduction

India has been spinning and weaving cotton for a long time. It is the second-largest producer of it in the world. Initially, cotton industries were developed in Maharashtra

and Gujarat due to the availability of a moist humid climate. The cotton textile industry supports the Indian economy.

Body

- Nowadays, the moist climate can be generated in an artificial way. The cotton industry is not weighted losing raw material hence cotton industries are seen in the other part of India also.
- At present. the High concentration of the cotton textile industry belt is seen in Maharashtra, Gujarat, and Tamil Nadu because of the several favourable factors.

Initial phase of cotton and textile industry Bombay was the main focal point of all development in cotton textile industry. Following were the factors around Bombay:

- Parsee merchants had huge finances from cotton and opium trade with China and raw cotton export USA during Civil War.
- Technical expertise was made availability by European firms
- Large cotton growing areas made raw materials easily available for new mills; they were already being exported through Mumbai.
- Port facility allowed for the import of machinery, chemical etc.
- Development of railways, in and around the Mumbai region facilitated the growth of Cotton Textile Industry.
- Availability of cheap unskilled labour.
- Climate advantage was there, humidity helped spinning without breakage.

During World War I demand increased, supplies from other countries reduced, leading to the growth of the industry. Also, the Swadeshi movement contributed to the development of the Cotton Textile Industry.

At the same time, the industry dispersed and other centers emerged. Ahmadabad was another major center. Other centers were Surat, Kalyan, Thane, Vadodara, Bharuch, and Pune. Factors that supported dispersion included.

- Raw material availability at other places as well
- Land cost increased in Bombay
- Trade Unions were emerging in Bombay.

The dispersion of Cotton Textile Industry was two-directional:

- North Direction – Delhi (Malwa plateau region provided cheap raw materials). Also, princely states took interest in the development of the Cotton Textile Industry. They provided free land and capital. Labour was also very cheap. Further, nearness to the market of North India facilitated the development of the Cotton Textile Industry in the north.
- Eastern diffusion was mainly on the Telangana and Deccan lava Plateau area. Cotton Textile Industry expanded up to Nagpur in the east and Hyderabad in the South East.

Post-independence, new modern factors were undermining the distribution of location with increased production:

- Development of irrigation: in the old alluvial regions of the country, mainly in the regions of Green Revolution,

- Soil moisture: The industry made rapid progress in Punjab, Haryana, West UP, and Delhi. Jalandhar, Ludhiana, Pathankot, Amritsar in Punjab, Ambala, and Faridabad in Haryana. Agra, Saharanpur, Ghaziabad, Modinagar in UP (Cotton needs soil moisture, not the surface water so thus soils which retain water for a longer time are favorable for cotton.
- Market Impact: India's tropical climate makes the whole country as a market. The Hoogly region in West Bengal emerged as a major region for Cotton Textile Industry.
- Market is the second most important factor responsible for the development of these industries. Situated in the tropics and sub-tropics the country enjoys a warm climate and cotton cloth is in use for the whole year in the peninsula and for most of the year in the Great Plains.
- Power looms: Power looms accounts for 85% of total production in Cotton Textile Industry. They are concentrated in Maharashtra, Gujarat, Tamil Nadu, Uttar Pradesh, Madhya Pradesh, West Bengal and Karnataka.
- Handlooms – They account for 12.5% of the total production in Cotton Textile Industry. They employ nearly 6 million people. There are nearly 38 lakh handlooms in India in which about one-third are located in Tamil Nadu, Andhra Pradesh, Assam, Uttar Pradesh and rest in Maharashtra, West Bengal, Bihar, Orissa, Rajasthan and Karnataka.
- Cheap labour: Since cotton wearing was a traditional cottage industry, chiefly concentrated in the cotton tracts of the country, cheap skilled labour was easily available in such areas.
- Transportation and availability of port: Cheap and efficient means of transport abundant power and fresh water and above all enterprise played some role in the development of the industry in the various part of the country.

Recent new Patterns in Cotton and Textile Industry determine location are:

- Mills are encouraged to locate the specialize in spinning while small units and handloom cooperatives specialize weaving.
- Decentralized sector weaving and packing in different households or slums becoming more important in production of fabrics.
- The Indian cotton textile industry has been facing increasing competition in world markets. hile Indian major competitors like China, Taiwan and South Korea are using the latest machinery, Indian textile industry is saddled with absolute machinery.

Conclusion

Since the cotton textile industry is old in India and a number of mills were set up long back, the machinery and equipment have grown old and outdated and need fast replacement. Government measures like ATUFS, SITP, textile park, SAMARTH must be rightly coordinated and aligned to modernize and globalize Indian textile and apparel sector.

2. How does technology reduce geography's importance as a locational factor? Explain with the help of suitable examples.

Approach

Question can be approached while detailing a historical evolution of relation between geography and technology. Relation between technology and geography can be established followed by the argument of prisoners of geography. In the end, conclusion can be given.

Introduction

The earliest humans were interested in a variety of geographical questions, including where were food, water, and friends; how long did it take to move between place A and B, and how could they illustrate familiar surroundings? We have witnessed advances in our thinking from localized worlds to regional worlds, from flat worlds to oceanic and transoceanic worlds. Today, we have virtual worlds in which geography and distance don't seem to matter.

Body

Technology and geography

- With the rise of the Internet and the new era of globalization, some have argued that the world is flat — geography is dead
- Location has always been a vital resource in business or in politics. But then along came the internet in the 1980s, and suddenly distance-related business costs collapsed for transactions, communications, transportation, and search. The web was the 'death of distance,' a concept popularized in 1997 by Frances Cairncross's book of the same title.
- Even though the internet didn't eliminate geography, it has had an impact. Communication costs are lower on the internet because it is inexpensive to communicate with others, whether they are in the same building or across the world.
- Transportation costs became lower in two ways. First, for goods that can be digitized, distribution is nearly free. Second, online interactions reduce the need for travel. The reduction in search costs on the internet follows directly from the other lower costs.
- If communication costs and transportation costs fall, then it is easier to compare potential choices before making a selection.

PRISONERS OF GEOGRAPHY

- Despite advances in information technology, countries (and those living in them) are what Tim Marshall calls "prisoners of geography."

- Marshall argues that all sorts of decisions, but especially political decisions, are influenced by geography as decision-makers confront the reality of the Earth's mountains, rivers, valleys, and oceans.
- Tim Marshall's book is a reminder of the salience of geography in international affairs.
- Locations blessed with the right climate, resources, and access to global markets will always do better than countries without such gifts. The question today is how will climate change alter those variables.
- Geography and distance affects trade and resources. As globalization became a major feature of the world economy, geography and distance began playing a more (not less) important role in supply chain operations.
- Since World War II, logistics experts have conceptualized the economy anew by spatializing cost–benefit analysis and applying systems analysis to distribution networks. The 'revolution in logistics' has changed how space is conceived and represented, and transformed the practical management of supply chains.
- Supply lines stretching halfway around the world resulted in a "blurring" of what was "inside" and "outside" of national space, as well as businesses having to deal with myriad policy, regulation, citizenship and labor rights issues.

What lies ahead?

- Energy and associated transportation costs are likely to continue rising as the cost of fossil fuels increases and policy measures targeted at carbon emissions intensify. These cost pressures promote reductions in the 'length' of value chains.
- Information technology costs are likely to be driven lower through intense technological competition. This opens up opportunities for countries wishing to grab a slice of the new technology
- Not much has changed about the assessment of technology and geography over the past decade, with the possible exception that climate change has become a bigger issue.

Conclusion

Geography and distance will continue to affect decisions about the development and growth. But it is also true that with the fast changing pace of technology distance is becoming less important but it is not irrelevant as of now, it is still a dominant factor in economics and global politics.

3 With the help of suitable examples, discuss the locational pattern of wellness and hospitality sector in India.

Approach

In this question candidates need to write about locational patterns of hospitality and wellness sectors in India and how their growth happened over the period of time.In second part of answer explain this with suitable examples .

Introduction

The wellness sector has been booming since the past couple of years as alternative therapies and measures are being deduced to shield the people of the country from sickness hazards. The Indian wellness industry was estimated at close to USD124.2billion in 2019-20 and is expected to grow at a compound annual growth rate (CAGR) of nearly 12% for the next five years. India was ranked 54th in the Travel & Tourism Competitiveness Report 2021 published by the World Economic Forum.

Body

Hospitality industry is an umbrella term used for all those industries involved in providing various services to travelers like transportation, food, lodging etc.

- The Indian tourism and hospitality industry have emerged as one of the key drivers of growth among the services sector in India.
- The Indian systems of medicine and homoeopathy particularly Ayurveda and Yoga are widely recognized for their holistic approach to health and capability for meeting emerging health challenges.
- The demand for Ayurveda, Yoga, Naturopathy, Unani, Siddha and Homoeopathy (AYUSH) and herbal products is surging in India and abroad
- The country has developed vast AYUSH infrastructure comprising of registered practitioners, dispensaries and hospitals in public sector, undergraduate colleges.
- India is a rich country in terms of biodiversity. Of the 17,000-18,000 species of flowering plants found in India, 7,000+ are estimated to have medicinal usage.
- Around 1100 species of medicinal plans are estimated to be in trade, of which 242 species are annually consumed in excess of 100 metric tons/year.
- India has 15 Agro-climatic zones.
- The medical tourism market in India is expected to grow from US$ 3 bn to US$ 7-8 bn by 2020.
- The Tourism and Hospitality industry in India is one of the largest service industries. The Tourism and hospitality industry in India is an employment generating industry and every $1 Mn invested in tourism creates 78 jobs.
- The World Heritage List has 36 sites inscribed which include 28 cultural, 7 natural and 1 mixed category site. There are 3686 monuments/sites under the protection of the Archaeological Survey of India.

- Services in the fields of food & beverage, recreation, lodging, travel and tourism all accounts to Industry of Hospitality. In the Globalization era, this industry has become a safe bet for businesses.

CONDITIONS FAVOURABLE FOR THE INDUSTRY-

For any country the following factors play catalyst in industry's growth.
NATURAL factors: Islands, beaches, climatic factors, Animals etc attracts huge no. of peoples.
REGULATORY drivers: Providing tax holidays to star hotels, exemption of luxury taxes, Medical Visas, and a liberal visa policies.
INTERNAL drivers : Proper infrastructure for transport & shelter, hosting major sport events, assuring peace and security etc.
EXTERNAL drivers : a growth in economy, increasing incomes, various pacts between nations etc.

Locational patterns of wellness and hospitality industry

- **Scenic beauty** -Rich heritage and cultural locations towards which people attracted for knowledge and curiosity. E.g. In India like Forts in Delhi and Rajasthan, Ancient temples of Orissa and Tamil Nadu, Ajanta Elora caves in Maharastra etc.
- Good tourism sites like hill stations, sea beaches, valleys etc. For example; Switzerland, Venice. In India, HP, north eastern regions, Goa and Chennai beaches, natural site of Kerela etc.
- Peaceful region without much crime or other related problems. E.g. Kashmir is one of the best tourist attracting region with beautiful hill stations, valleys, natural sceneries but due to terrorism, people avoid going there.Mahabaleshwar in Maharashtra , Ooty in Tamilnadu ,
- Locations with easy accessibility with good staying conditions and restaurants and market near these locations. E.g. Mussoorie, Haridwar, Rajasthan forts etc.
- People-friendly locations with local people have friendly nature towards tourists with good and local skilled tourist guides.
- **Medical tourism** (also called medical travel, health tourism or global healthcare) is a term used to describe the rapidly-growing practice of travelling across international borders to seek healthcare services. Services typically sought by travelers include elective procedures as well as complex surgeries, etc.
- India holds advantage as a medical tourism destination due to following factors:
- Most of the doctors and surgeons at Indian hospitals are trained or have worked at some of the medical institutions in the US, Europe, or other developed nations.
- Most doctors and nurses are fluent in English.
- Top -of-the-line medical and diagnostic equipment from global international conglomerates is available at many Indian hospitals.

- Indian nurses are among the best in the world. Nearly 1000 recognized nurses-training centers in India, mostly attached to teaching hospitals, graduate nearly 10,000 nurses annually.
- Even the most budget-conscious traveler can afford first-rate service and luxury amenities
- **Entertainment**-Entertainment sector includes activities that you attend such as festivals, concerts, cinema, and clubs.
- This is not only about entertainment that requires an 18+ identification. Entertainment for a younger audience is closely intertwined with Attractions, many attractions host entertainment activities.Mumbai as city of dreams attracts most of entertainment crowd .
- **Recreation**-Recreation is closely related to entertainment but is not the same. Recreation is about the things you do (or don't do) rather than activities that you attend.
- Recreation includes a spa, wellness, fitness and other things you would like to do to keep yourself healthy and happy (or not do, like all the things you wouldn't do when you're on a beach holiday).Kerala and Uttarakhand attracts crowds for recreation
- **Technology**-Yes, technology has become its own sector in the hospitality industry. Previously simply a range of suppliers that provide hotels with tools to manage their bookings, now a flourishing tech business sector.eg bengaluru ,delhi ,pune .
- **Meetings and Events**-This industry is often called MICE, which is short for Meetings, Incentives, Conferences, and Exhibitions. This involves all gatherings of people whether it is a small private event or a huge international congress at the largest expo on the continent.

Conclusion-

Indian wellness systems developed through centuries of wisdom of this ancient civilization, if fully tapped it will position India as a centre of Ayurveda, Yoga, Sidha, Naturopathy, etc. Together with the spiritual philosophy that has been integral to the Indian way of life. Never before were yoga and wellness retreats so much in demand. With a renewed stress on holistic well-being, nutrition and rejuvenation, as an aftermath of the pandemic. Industry experts say this might make India a focus point of international tourism, it being a hub of holistic streams of medicine such as Ayurveda, homeopathy, naturopathy, and Tibetan medicine and every other segment of hospitality industry.

4. Examine the factors that make India a medical tourism hotspot. What measures would you suggest to better exploit this potential? Discuss.

Approach

Candidates are expected to write about India's growing potential in MVT and try to define what is the Medical and Wellness Tourism, explain several factors that make India hotspot also suggest measures to enhance it.

Introduction-

Indian medical tourism market is expected to more than double it has emerged as a preferred healthcare and wellness destination for patients across the globe. As medical treatment costs in the developed countries are ballooning, more and more Western countries are finding the prospect of international travel for medical care increasingly appealing.

Body

Medical and Wellness Tourism:

- Medical & Wellness tourism may be defined as 'activities related to travel and hosting a foreign tourist who stays at least one night at the destination region for the purpose of maintaining, improving or restoring health through medical intervention'.
- India is one among the top five medical tourist spots in the world having hosted nearly 166,000 medical tourists from across the globe.

India holds an advantage as a medical tourism destination due to the following factors:

- India has over 500+ Accredited Healthcare providers (JCI & NABH) and uses world-class technologies at par with the western world. Indian Doctors are known for their excellence across the globe, one of the studies reveals that over 10 per cent of the doctors practising in the UK and US are Indian.
- High quality nursing capability providing high or equivalent standards of medical care as in patients home country.
- The cost of quality of medical procedures and services are low in India when compared to other competitors in the field.
- Use of modern medical technology, high-quality implants and internationally accepted medical supplies.
- Diverse geography with numerous tourism destinations to suit the patients schedule.
- Modern hospital and hotel facilities, good air and surface transport, developed tele-communications network and improving tourism infrastructure.
- Medical wisa norms have been simplified to ensure hassle-free visa for medical patient and attendant.
- India is known for offering alternative medicines and has certified and accredited wellness and ayurveda centres.

Steps taken for the Promotion of Medical and Wellness Tourism:

- The Ministry of Tourism, releases global print, electronic and online media campaigns in important and potential markets overseas, under the 'Incredible India' brand line.
- 'Medical Visa' has been introduced, which can be given for specific purposes to foreign travellers coming to India for medical treatment.
- 'E- Medical Visa' and 'E-Medical Attendant Visa' have also been introduced for 156 countries.
- The Ministry of Tourism provides financial Assistance under Market Development Assistance Scheme to Medical Tourism Service Providers accredited by National Accreditation Board for Hospitals & Healthcare Providers (NABH) for participation in Medical/ Tourism activities.
- The Ministry of Home Affairs (MHA) has taken several steps towards boosting medical tourism such as extending e-Visa to 161 countries. Besides, the MHA has extended the duration of stay on e-Visa from 30 to 60 days and also allowed triple entry in e-Medical Visa cases.

The Strategy and measures to be take:

- For this, a new National Medical and Wellness Tourism Board should be created as Minister of Tourism as its Chairman. It will provide a dedicated institutional framework to take forward the cause of promotion of Wellness & Medical Tourism.
- To create a robust framework and synergy amongst the Ministries of Central Government and State Governments and Private Sector for promoting India as a Medical Value Travel (MVT) and Wellness destination.
- India can further strengthen its standing among the current popular MVT destinations like Thailand, Singapore, Malaysia, Mexico etc.
- Wellness & Rejuvenation: Offerings focused on rejuvenation or for aesthetic reasons such as cosmetic surgery, stress relief, spas etc.
- Develop a brand for India as a wellness destination.
- Strengthen the ecosystem for medical and wellness tourism.
- Enable digitalization by setting up Online MVT Portal.
- Enhancement of accessibility for MVT.
- Promoting Wellness Tourism.
- Governance and Institutional Framework.
- Redressal of medico legal cases.
- Health/Wellness tourism leveraging AYUSH.

Conclusion

In order to strengthen its position on medical tourism, India would need to focus on dual objectives of 'tourism friendliness' and 'patient centricity'. However, achieving the stated vision of being 'The Provider to the World' would necessitate coordinated efforts by all key stakeholders be it government, providers, facilitators, regulators, insurers and soon.

5. Why do places like Silicon Valley or Bengaluru have so many startups? Examine.

Approach

Student can briefly discuss the factors behind the rise of Bengaluru as a manufacturing hub from independence. In the second part, startup ecosystem of Bengaluru and favourable environment in the city can be linked to showcase the rise of Indian silicon valley.

Introduction

India's youth population is the largest in the world. As per Bloomberg News analysis, "India is likely to have the world's largest workforce by 2027, with a billion people aged between 15 and 64." Bangalore, also known as "Silicon Valley", is one of the only place in India to find the perfect startup ecosystem. The city has one of the best entrepreneurial ecosystem and financial environment to start and grow a business.

Body

Historical overview

- After the country attained independence in 1947 that Bangalore evolved into a hub for public sector industries– particularly in aerospace, telecommunications, heavy equipment, space and defence – and saw massive investments from the government.
- This caused manufacturing giants like The Hindustan Aeronautics, The National Aerospace Laboratories, Bharat Heavy Electronics, Indian Telephone Industries and Bharat Earth Movers to have headquarters based in the Karnataka capital.
- Because of this concentration of technical and scientific manpower, Bangalore witnessed the IT revolution in the early 2000, And that caused more companies to come into Bangalore and venture into robotics, manufacturing marketplaces and tools for the manufacturing sector because they were being influenced by the ongoing ecosystem.
- The benefits of Bangalore's infrastructure and abundance of resources led many multinational corporations to follow suit and place their headquarters in the city.
- Indeed, the entrepreneurial spirit is being bolstered by various government initiatives aimed at supporting the city's startup scene. With the aim to escalate the number of new companies coupled with a commitment to foster entrepreneurship,

Why bengaluru has so many start-ups?

- In Bangalore, there is relatively easy access to a large number of venture capitalists and angel investors. With a great idea, the right state of mind, vision,

motivation and right direction for your startup, and it won't take you long to find your guardian angel here.

- A well-planned infrastructure is always needed for faster economic growth. In order to expand their business one requires having adequate infrastructure in the form of roads, railway transport system, ports, power, and airports.
- A planned infrastructure-from better road to faster broadband – is essential to give startups the confidence to grow, as it is necessary for businesses to deliver employment, growth and national prosperity.
- Bangalore is one of the top ranking cities in India that offers a highly developed infrastructure for startups to launch and is positioned number 84 globally among developed urban areas.
- Founding a startup in a cosmopolitan city where the cost of living remains low is always the preference of startup founders. In Bangalore, the cost of living still remains low compared to its big-cities.
- Bangalore city, home to between 1,800 and 2,300 active startups, has a majority of young, hardworking tech talent available compared to other startup hubs. Every day, Bangalore sees a huge influx of talent from all parts of the country making most of the talent available here.
- Bangalore is the city that organizes a wide range of meetups, hackathons and many other events every year. This fact contributes to one of the biggest reasons why the city is a heaven for startups.
- These events enable budding entrepreneurs to mingle with the community, get a chance to share their experiences of overcoming the challenges and achieving the goals.
- Along with technology, Bangalore has an abundance of ideas. A major advantage of being an entrepreneur in the Karnataka capital is that the ecosystem is still maturing. This means new ideas can be trialled and tested and there is plenty of room for innovation.

Conclusion

A strong community of engineers with global work experience, savvy customers and growing pools of early-stage capital, are transforming the city into a global startup hub. So, despite the potholed roads, patchy power supply and a mostly apathetic government, entrepreneurs flocking to Karnataka's capital say they are drawn by a unique culture of mentorship and networking that pervades the city.

1. The industrial revolution created several fissures in the European society. Do you agree? What were its major implications? Discuss.

Approach

Question can be approached by defining or explaining the industrial revolution and then highlight how it created different rifts candidates can write different social

economic and political angle to it and explain the implications of it on European society.

Introduction

The Industrial Revolution was the transition to new manufacturing processes in Europe in the period from between 1760 to 1820 and 1840.This transition included going from hand production methods to machines, new chemical manufacturing and iron production processes, the increasing use of steam power and water power, the development of machine tools and the rise of the mechanized factory system.

Body

- The Industrial Revolution came in time to Europe, but not to any important degree until about 1830. Manufacturing in the eighteenth-century France and Germany clustered in regions whose proximity to raw materials, access to markets, and traditional attachment to particular skills resulted in their development as industrial centers. Yet for a variety of reasons, these areas failed to experience the late eighteenth century breakthrough that occurred in Britain.

The Industrial Revolution also led to an unprecedented fissure in European society:

- Industrial revolution led to sharp divisions in society. The society got divided into two classes-the bourgeois and the proletariat. The former consisted of factory owners, great bankers, small industrialists, merchants and professional men. They amassed great wealth and paid very low wages to the workers.
- Due to industrial revolution, there was rise of cities was accompanied by the growth of slums. Before the advent of industrial revolution, the industry was scattered throughout the country. Artisans generally worked in their cottages or shops and were not entirely dependent on trade for their livelihood.
- They often combined manufacturing and agriculture. This was not possible after the growth of factories and the workers had to live at places near the factory. In the dark, dingy and dirty houses the workers fell easy prey to various types of diseases and often died premature deaths.
- The extremely low wages paid by the factory owners made it difficult for them to make both ends meet. As a consequence, they were often obliged to send their women and children to factories, where they worked on extremely low wages.
- The industrialists preferred women and children also because they were easy to manage. This exploitation of women and children resulted in "stunned bodies, deformed backs, horribly twisted legs, sunken chests and savage natures."

Implication of change due to industrial revolution:

- Industrial Revolution made the production of goods easy and ready in much less time. Therefore, more and more goods began to be produced which led to the exploitation of resources.
- Capitalism developed as an distinct ideology and business practice where profit was earned to invest more.
- It led to rise of exports and trade all over the world. As the articles were produced in surplus it required the markets.
- Industrial Revolution caused competition for colonies among the European countries and rivalry, particularly between Britain and France. Later on Italy, Germany and other countries also competed for colonisation.
- The imperialist expansions resulted in a struggle for supremacy and these led to two World Wars later.
- Exploitation of colonies and destruction of their traditional social, economic and political systems.
- Workers in coal mines suffered from many health complications like lung diseases with blasting technique. Long working hours on low wages.
- Women and children were discriminated and were paid very low wages. Bad working conditions like factories were poorly ventilated, dirty, noisy, dark and damp environment.

Conclusion

Industrial Revolution changed the methods of production and transformed social and economic life in a great way. This played an integral role in laying the foundations for the modern society and became a harbinger for future inventions for the betterment of humankind. However, it created new class divisions that led to economic and social inequalities. The adverse effects of Industrial Revolution later culminated into world wars.

2. Comparing the American and french revolutions, what similarities and differences do you see? Analyse.

Approach

A simple straightforward question where candidates need to write about American and french revolutions, In second part of answer compare these both revolutions and analyse what are the similarities and what are differences this both revolutions have .

Introduction

The American and French Revolutions are two of the defining changes of world history which were based on similar ideals of liberty and equality envisaged by thinkers like John Locke. The American revolution led by the slogan "no taxes without representation" led to independence from British. French revolution led to the

dethronement of the king and freed class divisions in France where people of lower classes suffered from heavy burden of taxes. Hence, both the revolutions led to more power in the hands of common people, thereby paving the way towards stronger democracy later.

Body

The American and the French revolution gave an impetus to the people worldwide for changing the monarchial and colonial set of rules which had grabbed the minds of people since long. Enlightenment opened up new avenues to think, it proved to be a barrier breaking moment since rationality was promoted.

Similarities between American and french revolutions

- The American and French Revolutions were fought several years and an ocean apart. However, they feature enough similarities that some people initially consider them "mirror struggles." After all, there are some easy comparisons: both revolutions occurred in the later eighteenth century. Both subverted an existing, monarchical government. Finally, both created ripe conditions for constitutionalism and deep patriotism.
- But dig more deeply, and you'll find that this "same revolution, different continent" concept is not as tidy as it initially appears. Further similarities between the two revolutions are just different enough to produce profound distinctions between the two revolutions.
- Although most scholars believe that the two revolutions influenced one another (as well as had profound worldwide impact), each revolution is a very distinct and singular struggle for freedom, identity, and an improved way of life.
- Both the American Revolution and the French Revolution were borne of dire economic conditions.
- Economic challenges definitely contributed to the basis for both revolutions. However, each nation's money-related woes were quite unique. The American Revolution had roots in the financial pressure that Britain placed on the New World; because Britain was economically dependent on the colonies, it kept taxing them.
- Both revolutions were undertaken with the goal of independence in mind.
- The American Revolution was not initially or even primarily fought for independence. Independence almost became a "by-product" of the colonists' initial attempt to remove unfair taxes levied on them by British Parliament.
- On the other hand, France's decades of class division and its burgeoning interest in thinkers like Rousseau (who emphasized the importance of human rights) sparked a popular interest in a more independent way of life. The influence of speeches, articles, and pamphlets from gifted writers and orators like revolution leaders Jacques-Pierre Brissot and Maximillien Robespierre also fueled this desire for freedom.
- The American and French revolutions were both extremely important in the changing path of world history.

- Even with different outcomes and variances in successes, the impact of both cannot be denied.
- The Causes of the French revolution and the American revolution are similar because they both were partially prompted by an over-reaching monarch, another similarity was that both revolutions were started by the commoners who wanted revolution to improve their lives**,**
- The American and French revolutions were inspired by the intellectual class with thinkers laying the foundations of the change that was to come.
- The ideas of Paine aimed at liberating the American people from the economic exploitation of the British
- The seeds of French liberation from its aristocracy were sown by Rousseau and who proclaimed that Kingship was not God
- The awakening of masses in America was done by Benjamin Franklin similar to the enlightenment of people by the ideas of Voltaire who advocated liberty
- Locke had great influence on the American revolution and its constitution through his ideas of natural rights over life, property & liberty while Didronet came out solutions to the problems of the French

Differences between American and french revolutions

- Location is a key difference between the two wars. The American Revolution took place in a colony an ocean away from its ruling monarchy in Britain. The French Revolution took place within France itself, an action that directly threatened the French monarchy.
- The difference in location also affected the intent of each revolution. American revolutionaries were not looking to change Britain's monarchy; they simply desired to be free from its rule.
- On the other hand, French fighters demanded fundamental changes be made to the way they were governed. In essence, Americans intended to break away to form a new government and establish a new country, whereas in France, the intent was to replace or change the existing government.
- The members of the Continental Congress in the American colonies drafted the Declaration of Independence to separate themselves from Britain and to express their belief that every individual has the equal opportunity right to "life, liberty and the pursuit of happiness." The American ideology was based on the works of British philosopher John Locke.
- France's Declaration of the Rights of Man and of the Citizen was founded on the teachings of French philosopher Jean-Jacques Rousseau, written with the aim to end the social and political inequalities of the time.
- Taxation played a role in both wars, however, the people's objections to the taxes in each country were dissimilar. Americans objected to the fact that colonists had no say in how the collected taxes were spent, or taxation without representation.
- However, American revolutionaries themselves were financially successful and lived relatively comfortable lives. In contrast, the revolting French peasants were starving and destitute as a result of over-taxation, and thus their fight was in part

driven by survival instincts. French revolutionists also objected to the inequality in the taxation -- French clergy and noblemen were taxed less than commoners.

- A significant difference exists in the categories of people fighting in each revolution. In France, the combatants were largely separated by economic classes – the rich from the poor. For Americans, the separations were ideological, in that the warring parties divided over loyalty to the crown and the desire for freedom. In some cases, differing political and philosophical views led to divisions within families and resulted in some soldiers fighting brother against brother.
- Slavery - Being an outright masses vs classes struggle, the french revolution led to the abolition of slavery in France and its colonies during the rule of the convention (although Napoleon would introduce slavery later). The American revolution which was mainly driven against imperialism did not affect slavery much and the USA had to wait till the civil war of 1860s to end slavery.
- Extent of success - The American Revolution was successful in achieving independence while the french revolution was a failure in the sense that it ultimately led to dictatorship by Napoleon although the ideals of the revolution would be effective later.
- Economic model - The American revolution established capitalist economy where feudalism continued exploitation in the form of slavery while the french revolution freed the people from bonded labour and feudalism, paving way for a more socialistic model.
- Hence, although both the revolutions had different impacts at home, their impact on the world, especially in fighting colonialism and declaration of human rights is huge.

Conclusion

French and American revolution not only laid the edifice for a newly emerging egalitarian society and a new way of polity in their respective countries but they also acted as the philosophical basis and aspiration of the people of other nations. The revolutions highlighted the fundamentals of a civilised world which continues to shape the global aspirations of today's time.

3 In what ways did the two world wars affect the dynamics between colonial powers and their colonies? Explain.

Approach

A simple straightforward question where candidates need to write about two world wars and how these two world wars affected the dynamics between colonial powers and their colonies , explain in details .

Introduction

World Wars brought about changes in the status of countries and continents. Colonial powers lost their positions of preeminence as superpowers and yielded place to new emerging powers, After the war, old powers were confronted with various domestic and external problems. Hence they could no longer hold onto their respective colonies Thus, the post-war world witnessed the end of colonialism in Africa and Asia.

Body

The weakening of the Imperialist Powers during WWI and WWII led to the demise of these nation's abilities to successfully directly rule their colonies. Because they no longer had as much control,

- WWI was largely caused because of conflict between the imperial powers of Europe. In the era before WWI, it became standard in Europe for countries with more imperial colonies to be seen as the strongest powers of the continent.
- The most developed European countries were all competing to get African colonies, which contained inexpensive labor and a cheap way to produce goods. This and the fact that nationalism fueled imperialism caused the increasing rivalry, tension, and conflict between the European nations,and often in the colonies themselves.
- All of the European superpowers felt they were the best, and each wanted to be the ultimate power—an impossible goal for multiple countries to have. While imperialist expansion wasn't the only reason behind WWI, it certainly helped cause it.
- Now to get to the point: because of imperialism and many other reasons, WWI struck Europe—and had an overall net weakening effect on direct imperial powers. One way WWI weakened these imperial powers is because the war caused them to spend loads of money.
- They needed to fight and defend themselves, protect their colonies—which were vital means of gaining profit—and finally, protect their nationalist pride and superpower status.
- By the time WWI ended, most of Europe was impacted financially, geographically, socially, politically, and culturally—almost completely in a negative way. While WWI weakened direct imperial influence overall, it is important to realize it affected each country differently, and to different extents.
- For example, the Treaty of Versailles, which ended the war at the Paris Peace Conference on June 28, 1919, severely weakened Germany's military force and forced them to give up a bunch of land. Poland, for instance, was re-established when Germany gave Poland's land back to them.

Specific Independent Movements

- As imperialistic powers no longer had as much control, people living in the colonies began to campaign for their rights, leading to many specific independent movements. The most notable movements include the ones that are discussed as follows.

- However, several other movements were able to eventually have positive results because of the weakened state of the European imperialist superpowers. There were many other additional movements including The Indian nationalist movement in South Africa. Mandela and the African independence movement did not occur until about a decade or so after WWII.

Indian independence movement after WW1

- The outcomes of WWI led to the weakening of direct imperial influence in the Indian Independence Movement in two ways:
- India's population grew stronger and more motivated to gain independence.
- Britain's imperialist hold significantly weakened. After the war, human anguish in India intensified.
- Heavy taxes, high inflation, an influenza epidemic, trade disruption, and high death rates were all caused by WWI and resulted in intense nationalism. Just as importantly, a nationalist movement made up of moderate and extremist groups stood as a unified front in politics and showed that India was capable of ruling themselves.
- Meanwhile, just after the war, Britain gave up a lot of power in India. In August 1917, Britain's secretary of state for India Edwin Montague announced in Parliament that the British policy for India was "increasing association of Indians in every branch of the administration and the gradual development of self-governing institutions with a view to the progressive realization of responsible government in India as an integral part of the British Empire."
- India was given even more hope when the Government of India Act 1919 was passed, introducing a diarchy. Elected Indian representatives and chosen British executives now shared power.

Vietnam: Post-WWI and WWII

- In contrast to the many other independence movements after WWI, Vietnam actually gained motive to attempt to gain independence after France strengthened their direct imperialist hold.
- This was still an outcome of WWI. Vietnam demanded more Vietnamese people to have political power, a modern bureaucracy, and the ability for all to become French citizens.
- While none of these demands were met, Vietnam still persisted, despite the odds not being in their favor, to gain independence, and very slowly progressed over time.

Africa's independence movement after world war 2

- Africa's main reason for wanting independence was because European imperialists had divided it in inappropriate ways that mixed the conflicting cultures of different tribes.

- The European Imperialists had drawn random boundaries between their African colonies with only their own convenience in mind. In contrast to the Independent movement of India, Africa was not nearly as successful, as Europeans still had great influence, particularly in terms of racial issues.
- Because of the weakened state of imperialism in Europe after the World Wars, especially of Great Britain, and partially by the influential successes of independence movements in other countries, South Africa was able to gain independence before WWII, and post-WWII independent movement efforts and leaders such as Mandela allowed other areas to gain independence as well.

Asia's independence movement after world war 2

- After the Second World War, the result was a significantly large rise of nationalism and decolonization. After World War II, European colonies still controlled more than one billion people all through the world.
- However, this powerful reputation of European was challenged when Japanese occupied large portions of British, French, and Dutch territories in the Pacific. This deterioration of European rule caused rapid growth of nationalist independence movements in Asia especially in Indonesia, Malaya, Burma, and French Indochina.
- There were many independence and anti-colonial movements in which those who rebelled were identified and arrested by colonial powers. This only strengthened Asia's fight for independence.

Conclusion

World wars caused the downfall of monarchies and made people more open to other ideologies, Asian and African men saw the brutality of Europeans, gained military skills and political awareness, and had less respect for rulers and expected better treatment as a reward for service. After the wars, colonial powers adopted ideas introduced during the war such as self-determination, liberty, and democracy among others. As a result, racism and exploitation in their colonies were reduced and movement for self governance eventually started.

4. What do you understand by the policy of apartheid? What role did Nelson Mandela play in the anti-apartheid movement? Discuss.

Approach

Candidates are expected to write about the policy of the apartheid and then elaborate it with basic information on what apartheid used to be. And then simply explain the role of Nelson Mandela in anti-apartheid movement.

Introduction-

Apartheid was a system of institutionalized racial segregation that existed in South Africa from 1948s to early 1990s for Imperial gains. It was characterized by authoritarian political culture based on baasskap (white supremacy). The economic legacy and social effects of apartheid continue to the present day.

Body

Policies under apartheid system:

- No voting rights for non-whites: The system of apartheid divided the people and labelled them on the basis of their skin colour. The white rulers treated all non-whites as inferiors. The non-whites did not have voting rights.
- Strict Segregation: The apartheid system was particularly oppressive for the blacks. They were forbidden from living in white areas. They could work in white areas only if they had a permit. Trains, buses, taxis, hotels, hospitals, schools and colleges, libraries, cinema halls, theatres, beaches, swimming pools, public toilets, were all separate for the whites and blacks. They could not visit the churches where the whites worshipped.
- Ban on formation of association and protests: Blacks could not form associations or protest against the extreme discriminatory treatment. This hindered their capacity to fight against apartheid peacefully.

Nelson Mandela in anti-apartheid movement:

- He set up a league comprising of youths the ANC Youth League – to gain support for non-violent protests against the National Party's racist laws, he travelled across the southern African countries. Authorities disliked this form of activism and thus, Nelson was arrested for treason for being an anti-national element.
- In the late 1950s, the government banned anti-apartheid groups such as the ANC. But that didn't stop Nelson and his fellow activists.
- For a needed big change, in the year 1961 Nelson and other ANC leaders formed a secret military group called Umkhonto we Sizwe, or Spear of the Nation.
- He was aware of the fact that he could get caught for his secret army. Thus, he kept a very low profile thus living in hiding and disguising himself. Unfortunately, in August 1962, he was arrested on his return trip from Algeria in Northern Africa and was sentenced to five years in prison.
- In 1963, the police raided and found documents belonging to the secret army, as well as weapons. Thus, Nelson and seven other men were charged and given life sentences.
- Nelson was first sent to prison on Robben Island, Cape Town, South Africa's capital city. He was moved to Pretoria Local Prison to appear in court, then returned to the Island prison for nearly ten years. In 1982, Nelson was transferred to Pollsmoor Prison. In 1988, he was finally transferred to Victor Verster Prison near a town called Paarl.

- He spent the first 18 years of his incarceration at the Robben Island Prison. Later on, he was transferred to Pollsmoor Prison. Mandela was released on 11th February 1990.
- During his service in the prison, he refused freedom on two occasions and instead chose to stand by his principles.
- Even though initially he took part in the armed struggle, at the first opportunity, he opted to negotiate peacefully with his previous persecutors because an armed struggle was against his nature.
- Mandela demonstrated physical, mental, spiritual, and emotional courage throughout his life and continued to lead, inspire, and stand against unfair injustices perpetrated against him and his people. He never considered his personal safety or wellbeing but always courageously put his people and his true beliefs first.
- When his tyrannical government convicted him of treason, he valiantly stood up, stated what he believed in, and declared that he was ready to die for his convictions. He gave up his all to guarantee that his dream of a free and equal South Africa would come to fruition.
- He inspired a generation of people to hope and never give up on what they believe in. He achieved what no one thought possible- a negotiated, peaceful transition to a democratic government. He unselfishly sacrificed himself, and willingly suffered for the good of all South African people.

Conclusion

Though Apartheid was exploitative and biased in all dimensions had to be scrapped off, with growing modernization and democratic values throughout the world. But, more importantly it would always remind us about the dark ages of human history and the way the struggle was carried out to end Apartheid, plays a huge role in the mental construct on the ideology of people around the world. The Struggle for Apartheid has strengthened the resolve for peaceful, nonviolent struggle around the world and increased the value for democracy.

5. How did the Cold War shape the politics of Afghanistan? Analyse.

Approach

The Question demands comprehensive understanding of issue. In the first part, reasons behind soviet invasion of Afghanistan can be given, followed by rise of Taliban. The events of 9/11 and US invasion of Afghanistan can be given along with the events followed. In the end, conclusion can be given.

Introduction

At the end of December 1979, the Soviet Union sent thousands of troops into Afghanistan and immediately assumed complete military and political control of Kabul

and large portions of the country. This event began a brutal, decade-long attempt by Russia to subdue the Afghan civil war and maintain a friendly and socialist government on its border. It was a watershed event of the Cold War, marking the only time the Soviet Union invaded a country outside the Eastern Bloc a strategic decision met by nearly worldwide condemnation.

Body

Why soviet invaded Afghanistan?

- The Saur Revolution had taken place in Afghanistan in 1978 which installed a communist party in power. Nur Muhammad Taraki became the head of the state replacing the previous president Daoud Khan.
- Taraki's government introduced many modernisation reforms that were considered too radical and left them unpopular, especially in the rural areas and with the traditional power structures.
- The communist government also had a policy of brutally suppressing all opposition. Even unarmed civilians opposing the government were not spared. This led to the rise of various anti-government armed groups in the country.
- The government itself was divided and Taraki was killed by a rival, Hafizullah Amin, who became the president. The Soviet Union, which at that time, wanted a communist ally in the country, decided to intervene.

What happened after invasion?

- The Soviet army was deployed on 24th December 1979 in Kabul. They staged a coup and killed Amin, installing Babrak Karmal as the president. Karmal was a Soviet ally.
- This intervention was seen as an invasion by the USA and other western nations. While the Soviet army had control of the cities and towns, the insurgency groups called the Mujahideen had the rural parts of Afghanistan under their control.
- A bitter war was fought between both groups. The Soviet Union, which had planned to stay for 6 months to a year in Afghanistan found themselves stuck in a war that was proving to be too costly.
- The Mujahideen did not relent in their pursuit to 'drive out the Soviets. They had the support of many countries like the USA, Pakistan, China, Iran, Egypt and Saudi Arabia. They were given assistance like arms and training needed to fight the Soviets.
- The Soviets followed a policy of wiping out the rural regions in order to defeat the Mujahideen. Millions of land mines were planted and important irrigation systems were destroyed.
- As a result, millions of Afghan refugees took refuge in Pakistan and Iran. Some came to India as well. It is estimated that in the Soviet-Afghan war, about 20 lakh Afghan civilians were killed.

- In 1987, after the reformist Mikhail Gorbachev came to power in the Soviet Union, he announced that his government would start withdrawing troops. The final Soviet troops were withdrawn on 15 February 1989. Now, the government of Afghanistan was left alone to fight the Mujahideen.
- Finally, they succeeded in taking control of Kabul in 1992. Again, the Mujahideen had different factions within and they could not agree on power-sharing. The country collapsed into a bloody civil war.

Rise of Taliban

- In 1994, a group of fundamentalist students wrought control of the city of Kandahar and started a campaign to seize power in the country. They were called the Taliban.
- Many of them were trained in Pakistan when they were in refugee camps. By 1998, almost entire Afghanistan was under the control of the Taliban. Many of the Mujahideen warlords fled to the north of the country and joined the Northern Alliance who were fighting the Taliban.
- This time, Russia lent support to the Northern Alliance, though they were fighting against them earlier.
- The Taliban ruled the country under a strict interpretation of the Sharia law and much of the progress with regard to women and education which the country had seen earlier, were reversed. Girls were forbidden from attending schools and women were banned from working. The Taliban-ruled country also became a safe haven for international terrorists.
- In 2001, a US-led coalition defeated the Taliban and established another government in place.
- On 11 September 2001, attacks in America killed nearly 3,000 people. Osama Bin Laden, the head of Islamist terror group al-Qaeda, was quickly identified as the man responsible.
- The Taliban, radical Islamists who ran Afghanistan and protected Bin Laden, refused to hand him over. So, a month after 9/11, the US launched airstrikes against Afghanistan.
- As other countries joined the war (ISAF), the Taliban were quickly removed from power. But they didn't just disappear – their influence grew back and they dug in.
- Since then, the US and its allies have struggled to stop Afghanistan's government from collapsing and end deadly attacks by the Taliban.

Aftermath of US invasion

- War between US and Taliban lasted longer because of the combination of fierce Taliban resistance, the limitations of Afghan forces and governance, and other countries' reluctance to keep their troops for longer in Afghanistan.
- As a result, the Taliban were able to regroup. When international forces withdrew from fighting, Afghan forces left to lead the charge were easily

overwhelmed. To make matters worse, Afghanistan's government, which is full of tribal division, is often hamstrung.

- Now as Taliban is in control officially, there are blatant violations of human rights and strict implementation of sharia. The politics of afghan society has been radically changed in the cold war period.

Conclusion

Along with US and Russia, china has also been trying to influence the situation in Afghanistan. With multiple players in picture and fundamentalist government in power, Afghanistan politics is at the lowest in decades. The worst sufferers are common civilians, who are fighting for basic necessities.

1. Briefly discuss the geography of the Great Barrier Reef. How does it affect Australia? Explain.

Approach

Question can be approached by information about the corals or Great barrier reef and then simply explain the unique features of the great barrier reef and then how it impacts Australia in overall.

Introduction

A coral reef is an underwater ecosystem characterized by reef-building corals. Reefs are formed of colonies of coral polyps held together by calcium carbonate. Most coral reefs are built from stony corals, whose polyps cluster in groups. Often called "rainforests of the sea", shallow coral reefs form some of Earth's most diverse ecosystems for example great barrier reef.

Body

- The corals have a symbiotic, or mutually beneficial, relationship with the zooxanthellae. These algae live inside the coral polyp's body where they photosynthesize to produce energy for themselves and the polyps. The polyps, in turn, provide a home and carbon dioxide for the algae. Additionally, the zooxanthellae provide the coral with their lively colours.

Great barrier reef:

- The Great Barrier Reef is a site of remarkable variety and beauty on the north-east coast of Australia.
- It contains the world's largest collection of coral reefs, with 400 types of coral, 1,500 species of fish and 4,000 types of mollusc.

- The entire ecosystem was inscribed as World Heritage in 1981, covering an area of 348,000 square kilometers, and is one of the seven wonders of the natural world.
- This reef structure is composed of and built by billions of tiny organisms, known as coral polyps.
- They are made up of genetically identical organisms called polyps, which are tiny, soft-bodied organisms. At their base is a hard, protective limestone skeleton called a calicle, which forms the structure of coral reefs.
- These polyps have microscopic algae called zooxanthellae living within their tissues. The corals and algae have a mutualistic (symbiotic) relationship.

Significance of great barrier reef and how it affects the Australia:

- The diversity of species and habitats, and their interconnectivity, make the Great Barrier Reef one of the richest and most complex natural ecosystems on earth.
- There are over 1,500 species of fish, about 400 species of coral, 4,000 species of mollusc, and some 240 species of birds, plus a great diversity of sponges, anemones, marine worms, crustaceans, and other species.
- It also comprises endemic species and threatened species as listed by the International Union for Conservation of Nature (IUCN). It is also one of the major tourist attractions in the country and contributes to the economic development of the Australia.
- The ocean warming and marine heatwaves will cause the loss and degradation of tropical shallow coral reefs, leading to "widespread destruction" of coral reef ecosystems. If bleaching persists, the IPCC estimates 10,000 jobs and AUD1 billion in revenue would be lost every year from declines in tourism alone in Australia.
- It is the primary habitat for more than thousands of different species of fish, mollusks, sea snakes, sea turtles, whales, dolphins, birds and more. Their destruction can lead to the extinction of thousands of species of marine life.
- They reduce the damage in case of storms, hurricanes and tsunamis by absorbing wave energy and contribute to environmental protection through the reduction of coastal erosion.
- They protect ecosystems located between the reefs and coasts, such as seagrass and lagoon for example, and human settlements located by the sea. Reefs also protect the highly productive wetlands along the coast.
- The Great Barrier Reef is also one of the largest carbon sinks in the world. Its mangroves and seagrasses absorb carbon from the atmosphere and store it, cleaning our air and helping mitigate the effects of climate change.
- The reef actually serves to help purify the water and air. This is because corals help to filter out the sediment in the ocean through their feeding process. As a result, the water around them is much cleaner. Similarly, algae often grows on corals. Much like other plants, algae get their nutrients from photosynthesis, a process that uses carbon dioxide.

Conclusion

Coral reefs deliver ecosystem services for tourism, fisheries and shoreline protection. They are also are a source of food and new medicines. The need of the hour is to protect coral reefs by reducing and eventually eliminating dumping materials and chemicals, reduce fishing and monitor the water quality of run-off directed toward the reef. Healthy reefs lead to healthy oceans, and healthy oceans are vital to all life on Earth.

2. Discuss the significance of the Great Artesian Basin for Australia. What are the threats posed to the basin by human activities? Examine.

Approach

Candidate can describe the formation of artisan basin. In the body part, formation of great artisan basin can be given followed by the significance of GAB for Australia. In the end, environmental concerns can be given along with the conclusion.

Introduction

An artesian basin is a low-lying region where groundwater is cramped under pressure from surrounding layers of rock. These basins are usually found where an aquifer is present in a syncline, by impenetrable layers above as well as below. Whenever a fissure breaks the surface, the underground water blow up. This results in the rising of the water level to a point where hydrostatic equilibrium has been achieved.

Body

The Great Artesian Basin (GAB)

- The Great Artesian Basin is the largest and deepest artesian basin in the world. It is located within Australia, stretching over 1,700,000 square kilometres, and is huge enough to fill Sydney Harbour 130,000 times.
- The temperatures range from 30–100 °C. This artesian basin is the only dependable and safe source of fresh water for the rural communities. It holds 23% of the continent, and is 3,000 metres deep, consisting of 64,900 cubic kilometres of groundwater.
- During the Triassic, Jurassic, and early Cretaceous periods, the water of the GAB was retained in a sandstone layer placed by continental erosion of higher ground.
- Going back to the time when much of the present day inland Australia was below sea level, the sandstone was covered by a layer of marine sedimentary rock, which formed a confining layer, thus grasping water in the sandstone aquifer.

- When the Great Dividing Range developed, the eastern edge of the basin was elevated. The landforms of the Central Eastern Lowlands and the Great Western Plateau created the other side of the basin.
- The recharge water mostly invades the rock formations from rather high ground near the eastern edge of the basin, and very steady flows towards the south and the west. A small quantity of water enters along the western margin in arid central Australia, which flows to the south and the east.
- As the sandstones are permeable, water moderately paves its way through the pores between the sand grains, and hence flowing at a rate of 1-5 meters per annum.

Significance of GAB for Australia

- The discovery and use of the water in the Great Artesian Basin allowed the settlement of thousands of square kilometres of country away from rivers in inland New South Wales, Queensland, and South Australia, that would otherwise have been unavailable for pastoral activities.
- The Great Artesian Basin became an important water supply for cattle stations, irrigation, and livestock and domestic purposes, and is a vital life line for rural Australia. To tap it, boreholes are drilled down to a suitable rock layer, and the pressure of the water often forces it up without the need for pumps.

Environmental concerns

- There is a strong debate surrounding coal seam gas (CSG) drilling and hydraulic fracturing in GAB area.
- Over thirty chemicals may be used in the process of hydraulic fracturing and their long-term impact on aquifers, agriculture and people supported by them has been quantifiable and verified for quite some time.
- Lead, aluminium, arsenic, barium, boron, nickel and uranium have all been found beyond recommended levels in the groundwater contaminated by CSG.
- Instances of groundwater being contaminated and by extension poisoning the ecosystems sustained by the availability of groundwater have been widely documented, and are an exacerbating factor in regards to the population's capability to cope with drought through usage of groundwater sources in Australia.

Conclusion

GAB is great source of natural drinking water, its contamination in the mining process will lead to forever depletion of important resource in the drought prone area. A sustainable approach towards the maintenance of natural resources is must.

3 What are anticyclones ,how do they affect weather conditions ? explain.

Approach

A simple straightforward question where candidates need to write about anticyclones, how do they form and their effect on weather formations. Explain the process in detail.

Introduction

Anticyclones are the polar opposite of cyclones, characterised by high atmospheric pressure and sinking air. No clouds or rain form because the air is sinking rather than rising. This is due to the fact that as the air sinks, it warms, allowing it to hold more water. An anticyclone is a weather phenomenon defined as a large-scale circulation of winds around a central region of high atmospheric pressure.

Body -

A system of winds that rotates about a center of high atmospheric pressure clockwise in the northern hemisphere and counterclockwise in the southern, that usually advances at 20 to 30 miles (about 30 to 50 kilometers) per hour, and that usually has a diameter of 1500 to 2500 miles

- Anticyclones are centres of high pressure. They are surrounded by closed isobars having decreasing pressure outward.
- The circulation is from central high pressure towards the periphery in such a way that air blows outwards in a clockwise direction in the Northern hemisphere and anticlockwise direction in the southern hemisphere.
- Due to Coriolis force, blowing winds are deflected from their paths to the right in the Northern hemisphere and left in the Southern hemisphere, that's how it gets circular with a flowing system.
- The difference of pressure between the centre and periphery of anticyclone ranges between 10 to 20 mb and sometimes higher.
- There are much larger in size and area than temperate cyclones as the diameter is 75% larger than that of temperate cyclones. Temperate anticyclones are very extensive that a single anticyclone can cover nearly half of the USA.
- The track is highly variable and unpredictable. They move very sluggishly and sometimes they become stationary over a particular place for 4 days. The average velocity of an anticyclone is 30 to 50 km per hour.
- Anticyclones are originated due to the descent of either polar cold air mass or warm tropical air mass.
- These anticyclones are high-pressure systems and are more common in subtropical high-pressure belts and polar high-pressure belts where the air is sinking from the upper troposphere to the lower troposphere but are practically absent in equatorial regions.
- The formation of anticyclonic conditions at polar high-pressure belts is a thermal phenomenon as these bills a thermally direct whereas the formation of

anticyclonic conditions at subtropical high-pressure belts is a dynamic phenomenon as these bills are thermally indirect.

- Hence, anticyclones of polar high-pressure belts are termed thermal anticyclones, and anticyclones of subtropical high-pressure belts are termed dynamic anticyclones.

Types of anticyclones:

- **Cold anticyclones or thermal anti cyclones:** They are formed above the Polar Regions due to the sinking of air. Post subsidence of air outflows from the polar region in an easterly and southeasterly direction.
- **Warm anticyclones or dynamic anticyclones:** They are formed above warm subtropical regions due to the sinking of air from the upper troposphere to the lower troposphere and consequent divergence of air.
- **Blocking anticyclones:** These developed due to obstruction in the air circulation in the upper troposphere that develops over mid-latitudes and are called blocking because they obstruct the flow of temperate cyclones in mid-latitudes.
- Anticyclones tend to produce fairly uniform weather. Whence descend from above at the centre and the weather becomes clear and rainless because the descending wind brings atmospheric stability. The weather of Canada USA and northern Eurasia is mostly affected by anticyclones.

How anticyclones affect weather conditions -

- cyclones are typically regions of inclement weather, anticyclones are usually meteorologically quiet regions. Generally larger than cyclones, anticyclones exhibit persistent downward motions and yield dry stable air that may extend horizontally many hundreds of kilometres.
- In most cases, an actively developing anticyclone forms over a ground location in the region of cold air behind a cyclone as it moves away. This anticyclone forms before the next cyclone advances into the area. Such an anticyclone is known as a cold anticyclone.
- A result of the downward air motion in an anticyclone, however, is compression of the descending air. As a consequence of this compression, the air is warmed. Thus, after a few days, the air composing the anticyclone at levels 2 to 5 km (1 to 3 miles) above the ground tends to increase in temperature, and the anticyclone is transformed into a warm anticyclone.
- Warm anticyclones move slowly, and cyclones are diverted around their periphery. During their transformation from cold to warm status, anticyclones usually move out of the main belt followed by cyclones in middle latitudes and often amalgamate with the quasi-permanent bands of relatively high pressure found in both hemispheres around latitude 20° to 30°—the so-called subtropical anticyclones.
- On some occasions the warm anticyclones remain in the belt normally occupied by the mid-latitude westerly winds. The normal cyclone tracks are then considerably modified; atmospheric depressions (areas of low pressure) are either blocked in their eastward progress or diverted to the north or south of the anticyclone.

- Anticyclones that interrupt the normal circulation of the westerly wind in this way are called blocking anticyclones, or blocking highs. They frequently persist for a week or more, and the occurrence of a few such blocking anticyclones may dominate the character of a season. Blocking anticyclones are particularly common over Europe, the eastern Atlantic, and the Alaskan area.
- The descent and warming of the air in an anticyclone might be expected to lead to the dissolution of clouds and the absence of rain. Near the centre of the anticyclone, the winds are light and the air can become stagnant. Air pollution can build up as a result.
- In winter the ground cools, and the lower layers of the atmosphere also become cold. Fog may be formed as the air is cooled to its dew point in the stagnant air. Under other circumstances, the air trapped in the first kilometre above Earth's surface may pick up moisture from the sea or other moist surfaces, and layers of cloud may form in areas near the ground up to a height of about 1 km (0.6 mile). Such layers of cloud can be persistent in anticyclones (except over the continents in summer), but they rarely grow thick enough to produce rain. If precipitation occurs, it is usually drizzle or light snow.
- Anticyclones are often regions of clear skies and sunny weather in summer; at other times of the year, cloudy and foggy weather—especially over wet ground, snow cover, and the ocean—may be more typical. Winter anticyclones produce colder than average temperatures at the surface, particularly if the skies remain clear. Anticyclones are responsible for periods of little or no rain, and such periods may be prolonged in association with blocking highs.

Conclusion

Although not as actively researched as cyclones, anticyclones are important because the clear, dry conditions usually associated with them may allow strong night time radiative cooling and cold surface temperatures. Anticyclones can bring us very cold, crisp bright winter days and warm, sunny summer weather. In winter, the clear, settled conditions and light winds associated with anticyclones can lead to frost and fog.

4. Located in South America, the northern Chilean region is one of the driest places on earth. Why? Explain.

Approach

Candidates are expected to write about Atacama desert and its surrounding region in northern Chile explain location features and why its called dirtiest place on earth.

Introduction

The Atacama Desert in northern Chile region is commonly known as the driest place in the world, especially the surroundings of the abandoned Yungay mining town, where the University of Antofagasta Desert Research Station is located, in Antofagasta Region, Chile.

Body

The Driest Place on Earth:

- The Atacama Desert is the driest place in the world. Located in Arica, Chile, its annual rainfall is only 0.03 inches. The landscape is so arid, that NASA's astrobiologists travel to the Atacama Desert hoping it will lead them to clues about life on other planets.
- The Atacama Desert is a strip of land on the Chilean coast, west of the Andes Mountains. The desert plateau is 990 miles long, and is the only true desert to receive less rain than the polar deserts.

Geophysical features of the desert make it look dirtiest:

- The Atacama Desert is located in a zone called the "shadow of rain". This is determined by its geographical location: between the Andes Mountain range, which blocks the humid air of the Amazons, and the Coastal Mountain range, which interjects between the air currents that come from the Pacific Ocean.
- In an average year, this desert is a very dry place. Arica, Chile, in the northern Atacama holds the world record for the longest dry streak, having gone 173 months without a drop of rain in the early 20th century. In another Atacama neighbor to the south of Arica, the average annual rainfall in the city of Antofagasta is just 0.07 inches.
- As El Niño strengthens, so does the rainfall increase across South America. As areas of low-pressure swing east into the Andes Mountains, the usually warm waters off the coast provide more than enough water vapor to fuel extreme rainfall events.
- An unusual spell of rains preceded the flowering; almost putting at stake the place's undesirable, but much-revered superlative of being the driest place on earth. Just two years ago, the desert had seen the flowering.
- The texture of the desert ground – which over three million years ago was part of the sea floor – is surrounded by numerous mountains and volcanoes.
- Then there's the fact that the Atacama has traded iconic desert sand dunes for snow-dusted peaks over 20,000 feet high. Since the desert is located in the rain shadow of two major mountain ranges, it misses out on much of the rest of the region's rainfall.
- These conditions have endured for eons; some scientists estimate that the land has been a desert for over three million years. That would mean the Atacama isn't just one of the driest places on earth — it's also the planet's oldest desert.
- It sits in a double rain shadow at a place that doesn't get much precipitation in the surrounding area in any event. That means that several places of the

Atacama get no precipitation of any kind for stretches of hundreds of years at a time.

- It's so desolate that even regular microbes can't survive, making the Atacama virtually sterile. The few microbes that do survive are specially adapted and, when it did have a heavy rain a couple of years ago, six distinct species were wiped out when they literally exploded from absorbing water.

Conclusion

Local residents of this lonely part of the planet had already perceived an imminent change in the climate. But they were not alone. Their "never before experience" with weather was also not a freak development, but part of a planetary level change sweeping across the globe. And this change was unfolding in extreme weather events, often contrasting, spanning continents, geography and demography. As it turned out, in the long-term, all of us are victims of deadly weather events.

5. What is Coriolis effect? How does it affect the weather pattern? Illustrate.

Approach

Question is straight forward. Candidate can define Coriolis force in detail while explaining its mechanism. In the second part, its effect on weather pattern can be given along with the conclusion.

Introduction

The Coriolis force is a force that is generated as the earth spins around its axis. In the northern hemisphere, this deflects the wind to the right, while in the southern hemisphere, it deflects the wind to the left. The Coriolis force is the force exerted due to the rotation of the earth that deflects the wind movement. The movement of the wind is also affected by friction caused by various relief features on the soil. For example, the wind blows faster and in the same direction over maritime surfaces; but, on land, the existence of mountains or valleys affects the wind's direction and speed.

Body

Coriolis effect

- The Coriolis effect, also known as the Coriolis force, is the outcome of the earth's rotation. The Coriolis force is the name for this force.
- It has a significant influence on wind direction. Winds are deflected from their initial direction due to the earth's rotation, rather than crossing the isobars at right angles as the pressure gradient force directs.
- Winds in the northern hemisphere are deflected to the right of their course, whereas those in the southern hemisphere are deflected to the left, according to Farrell's Law (the law that wind is deflected to the right in the Northern

Hemisphere and to the left in the Southern Hemisphere, derived from the application of the Coriolis effect to air masses).

- This deflection force does not appear until the air is placed in motion, and it grows as wind velocity, air mass, and latitude increase.
- The Coriolis force is perpendicular to the pressure gradient force (the pressure gradient force is perpendicular to an isobar).
- Because these two forces are perpendicular to each other, the wind blows in low-pressure zones.

Causes of Coriolis force

- The rotation of the earth is the primary cause of the Coriolis effect. Anything flying or flowing over a great distance above the planet's surface appears to be deflected when the earth spins counter-clockwise on its axis.
- This happens because when something moves freely above the earth's surface, the earth moves east at a quicker rate beneath the object.
- The Coriolis effect grows as latitude increases and the speed of the earth's rotation slows.
- A plane flying parallel to the equator would be able to maintain its position without visible deviation. The plane would deviate slightly north or south of the equator.
- Aside from the earth's rotational speed and latitude, the faster the object moves, the more deflection there will be.

Effect on weather pattern

- Almost all sciences that deal with Earth and planetary motions are affected by the Coriolis effect.
- It is vital to the dynamics of the atmosphere, including wind and storm motions.
- It explains the motions of oceanic currents in oceanography. The deflection of winds and currents in the ocean is one of the most significant geographical effects of the Coriolis effect.
- It also has an impact on man-made objects such as planes and missiles.
- The Coriolis force is zero at the equator (zero Coriolis Force = no cyclones), but it increases with latitude.
- At 5° latitude, the Coriolis force is strong enough to cause a storm. Between 10° and 20° latitude, about 65 percent of cyclonic activity occurs.
- The angle of latitude is directly proportional to the Coriolis force.
- It reaches its highest point in the poles and is completely absent near the equator.
- The wind blows perpendicular to the isobars at the equator (Coriolis force is zero).
- Because there is no Coriolis effect, the low pressure fills rather than intensifies, resulting in no spiraling of air.
- Thunderstorms are formed when winds are immediately elevated vertically.

Conclusion

Coriolis Effect in combination with a region of high pressure, causes the prevailing wind trade winds to travel from east to west across the 60-degree "belt" on both sides of the equator. Thus it is an important factor in climatology and plays an important role in weather patterns.

1. The distribution of natural resources plays a crucial role in determining the global geopolitical landscape. Elucidate.

Approach

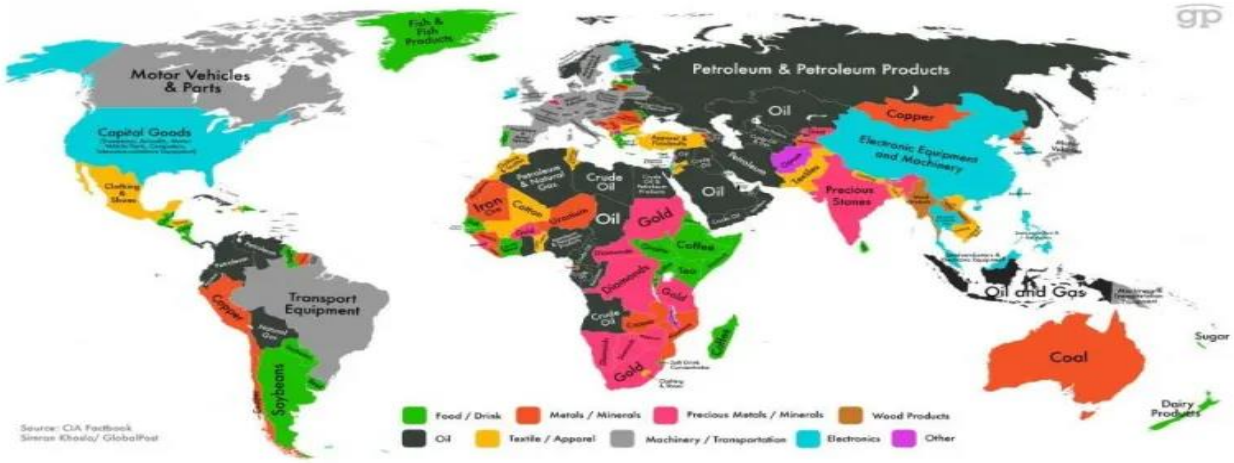
Candidates can start with giving basic information on natural resources and then highlight its importance in determining the geopolitical and strategic interest. Also elucidate with highlighting the different examples.

Introduction

Natural resources are distributed unevenly throughout the world. The territories of some nation-states, for instance, possess abundant mineral resources which are capable of commanding and determine global geopolitical landscape while others possess reserves of coal and iron capable of driving industrialization which directly affects global politics.

Body

Geopolitics is the study of the effects of geography on politics and international relations. The geographical factors include location, terrain and resources etc.
Of these resources, both physical (conventional and non-conventional) and human resources play an important role in shaping the geopolitics of the world.



(A rough map with important resources is sufficient)

Crude oil and natural gas present in Middle East region:

- Abundant sources petroleum has driven major countries of the world towards the Middle East.
- Emergence of economically stronger OPEC countries.
- Large amount of imports and remittances from these countries to India has drawn stronger relations and cooperation with Saudi Arabia, Iran and UAE etc.
- At the same time, the region has been witnessing complex geopolitical manoeuvring with conflicts, wars between terrorist organisations, rebel groups, militias and forces of various countries.
- The shifting of energy source from coal supplies to oil supplies has led to the Middle East becoming an essential epicentre of global geopolitics and to oil becoming a vital issue for national security.
- Since the second half of the 20th century, control of oil resources has played a central role in several wars, such as the Iran-Iraq War (1980-1988), the Gulf War (1990-1991), etc.

Resource rich South China Sea:

- The possible presence of oil and gas resources, polymetallic nodules and fisheries etc has driven interest of the nearby countries.
- This has given rise to conflicting situation among China and other South East nations who have overlapping territorial claims.

Human resources and presence of skilled labour:

- This have made developing countries like India and China supplier of human resources to the developed world, resulting in large scale migration. Of late, the diaspora presents there have become an important component of diplomacy.

The quest for new resources:

- Renewable energy: India has given emphasis on solar energy and has been cooperating with the countries using newly formed International Solar Alliance.
- Resource-rich Antarctic and Arctic regions have driven interest of the major powers of the world. Which resulted in conflicts among the competing

interests and at the same time cooperation in terms of treaties like Antarctic Treaty and establishment of Arctic Council.

- This reinforces the decarbonisation measures already in place in several parts of the world.
- Meanwhile, technological advances have increased the competitiveness of solar and wind energy technologies, batteries and electric cars.
- This quest for new resources has driven competition and cooperation among major powers to look beyond Earth to other celestial bodies like Mars etc.

Global Warming & Global Concern:

- The global concern for more than half a century oil and natural gas have been at the heart of the geopolitics of energy. However, the over-dependence on oil & gas has brought the global issue of global warming into the forefront.
- Many important events like the Kyoto Protocol signing & Paris Agreement marked the critical steps forward in global efforts to respond to the challenge of global warming.

Supply of Rare-Earth Mineral:

- The rapid development of wind and solar energy, together with that of electric cars, raises concerns about the security of supply of the minerals needed to manufacture them.
- The dominance of China in the supply of these rare minerals and current geopolitical tension between US & China could trigger a case like the 'cobalt crisis' of 1978.

Depletion of resources:

- In few countries has given rise to the migration of people which has resulted in Refugee problems.
- Also, the depletion of environmental resources has brought the countries together to have cooperation in the field of afforestation, biodiversity, climate change etc resulting in treaties and establishment of multilateral bodies. Recent Paris treaty is an example to it.

Conclusion

Natural resources are becoming the new powerful key to defining geopolitics and securing economic and strategic interests. It is evident from the above examples that resources play an important role in having competition, conflicts and cooperation among the countries, giving shape to the complex geopolitical scenario

2. Briefly describe the global distribution of petroleum. What causes petroleum prices to fluctuate so much? Are India's imports geographically diversified enough to achieve energy security? Examine.

Approach

Question can be divided in three parts, in first part, distribution of petroleum reserves can be given followed by the factors behind price fluctuations in the market. In the end, india's oil imports can be critically analysed.

Introduction

More than half of the world's proven oil reserves are located in the Middle East (including Iran but not North Africa). Canada, United States, Latin America, Africa, and the region occupied by the former Soviet Union contains less than 15 percent of the world's proven reserves.

Body

Global distribution of petroleum resources

- Reserves are identified quantities of petroleum that are considered recoverable under current economic and technological conditions.
- The amount of oil a given region produces is not always proportionate to the size of its proven reserves.
- For example, the Middle East contains more than 50 percent of the world's proven reserves but accounts for only about 30 percent of global oil production.
- The United States, by contrast has less than 2 percent of the world's proven reserves but produces about 10 percent of the world's oil.
- The Arabian-Iranian sedimentary basin in the Persian Gulf region contains two-thirds of these supergiant fields. The remaining supergiants are distributed among the United States, Russia, Mexico, Libya, Algeria, Venezuela, China, and Brazil.
- The Arabian-Iranian sedimentary basin is predominant because it contains more than 20 supergiant fields. No other basin has more than one such field.
- In 20 of the 26 most significant oil-containing basins, the 10 largest fields originally contained more than 50 percent of the known recoverable oil.

Why petroleum prices fluctuate so much?

- Crude oil prices are determined by global supply and demand. Economic growth is one of the biggest factors affecting petroleum product—and therefore crude oil—demand. Growing economies increase demand for energy in general and especially for transporting goods and materials from producers to consumers.
- The price of oil, or the oil price, generally refers to the spot price of a barrel of benchmark crude oil—a reference price for buyers and sellers of crude oil such as West Texas Intermediate (WTI), Brent ICE, Dubai Crude, OPEC Reference Basket, Tapis Crude, Bonny Light, Urals oil, Isthmus and Western Canadian Select (WCS).

- There is a difference in the price of a barrel of oil based on its grade. Discussed below are the factors which are responsible for the increase or decrease in the crude oil pricing in India:
- Its specific gravity or API
- Its sulphur content
- Its location—for example, its proximity to tidewater and/or refineries. Heavier, sour crude oils lacking in tidewater access—such as Western Canadian Select—are less expensive than lighter, sweeter oil—such as WTI.
- Other factors affecting crude oil prices are,
- Demand: Constantly on the rise.
- Supply –for ex. Iran factor and low spare capacity.
- Inventories – Have dropped significantly; Demand is higher than supplies.
- Capital Expenditure: Future supplies at risk.
- Geopolitical Risks: for example, Iran factor and potential trade wars.

India's imports geographically diversified enough?

- India was the fourth-largest consumer of crude oil and petroleum products after the United States, China, and Japan in 2015.
- It was also the fourth-largest net importer of crude oil and petroleum products.
- The gap between India's oil demand and supply is widening, as demand in 2015 reached nearly 4.1 million barrels per day (b/d), compared to around 1 million b/d of total domestic liquids production.
- Demands accelerated in the year 2016 through 2017 timeframe as India's transportation and industrial sectors continue to expand under economic development, oil price declines since mid-2014.
- Dependence on imported crude oil has led Indian energy companies to diversify their supply sources.
- To this end, Indian national oil companies (NOCs) have acquired equity stakes in overseas oil and natural gas fields in South America, Africa, Southeast Asia, and the Caspian Sea region to acquire reserves and production capability.
- However, major chunk of crude oil and condensate imports continue to come from the Middle East, where Indian companies have little direct access to investment.
- Saudi Arabia is India's largest oil supplier, with a 20% share of India's crude oil imports.
- In total, approximately 58% of India's imported crude oil came from Middle East countries, mostly Saudi Arabia and Iraq.
- The second-largest source of oil imports is Africa (19%), with most of that crude oil coming from Nigeria.
- The Western Hemisphere accounted for 18% of India's crude oil imports, mostly from Venezuela and imports from this region have grown substantially over the past several years.

- Supply disruptions in several countries, including Iran, Libya and Sudan, in addition to India's growing dependence on imported crude oil, compelled India to diversify its crude oil import slate over the past few years.
- India has amplified its total net oil imports from 42% of demand in 1990 to an estimated 75% of demand in 2015.
- India's demand for crude oil and petroleum products is projected to continue rising, barring a serious global economic recession.
- Oil import dependence will continue to climb if India fails to achieve production growth equal to demand growth.

Conclusion

While India will remain a major importer of crude oil, any sharp spikes in the international price could pose bigger challenges. India imports 75% of its oil requirements thus making India vulnerable to global market fluctuations. Private Oil companies are losing almost 30$ per barrel. Coupled with a depreciating currency, the companies will lose out leading to many of them closing. There needs to be policy level intervention to address this problem.

3 What are gas hydrates ? why are gas hydrates envisaged as a viable major energy resource for the future ? Discuss .

Approach

A simple straightforward question where candidates need to write about gas hydrates, In second part of answer write about why gas hydrates envisaged as a major energy resource for the future . Discuss this in detail .

Introduction

Gas hydrates are a crystalline solid formed of water and gas. It looks and acts much like ice, but it contains huge amounts of methane; it is known to occur on every continent; and it exists in huge quantities in marine sediments in a layer several hundred meters thick directly below the sea floor and in association with permafrost in the Arctic. It is not stable at normal sea-level pressures and temperatures, which is the primary reason that it is a challenge to study.

Body

Natural gas hydrates are a naturally occurring, ice-like combination of natural gas and water. They are mainly found in oceans and Polar Regions

- Gas hydrates are crystalline form of methane and water, and exist in shallow sediments of outer continental margins. They are envisaged as a viable major energy resource for future.

- Promising sites of gas hydrates have been identified and surveyed in the Krishna-Godavari (KG) and the Mahanadi basins
- Methane gas hydrate is stable at the seafloor at water depths beneath about 500 m.
- Known as flammable ice, methane hydrates are molecules of gas contained in an ice matrix found in permafrost regions of the arctic and on the seafloor at continental margins below 500 meters of depth.
- Gas hydrates are also important for seafloor stability studies, because "melting" gas hydrate may cause seafloor "land" slides.
- Using methane from gas hydrate as an energy resource would be, compared to other hydrocarbons, relatively climate friendly as combustion of methane is twice as efficient as burning coal.

Importance of gas hydrates -

- The amount of gas within the world's gas hydrate accumulations is estimated to greatly exceed the volume of all known conventional gas resources.
- In India, gas hydrate resources are estimated at 1,894 trillion cubic meters (tcm) and these deposits occur in Eastern, Western and Andaman offshore areas.
- Gas hydrates may contain a major energy resource and It may be a significant hazard because it alters sea floor sediment stability, influencing collapse and landsliding .The hydrate reservoir may have strong influence on the environment and climate, because methane is a significant greenhouse gas.
- Gas hydrates consist of molecules of natural gas (the chief constituent of natural gas; methane) enclosed within a solid lattice of water molecules.
- When brought to the earth's surface, one cubic meter of gas hydrate releases 164 cubic meters of natural gas. Gas hydrate deposits are found wherever methane occurs in the presence of water under elevated pressures and at relatively low temperatures, such as beneath permafrost or in shallow sediments along deepwater continental margins.
- Methane that forms hydrate can be both biogenic, created by biological activity in sediments, and thermogenic, created by geological processes deeper within the earth. Once assumed to be rare, gas hydrates are now thought to occur in vast volumes and to include 250,000–700,000 trillion cubic feet of methane and the formation thickness can be several hundred meters thick.
- Early challenges associated with evaluating the production of methane from hydrates included confirming the existence and occurrence of quality reservoirs, demonstrating the ability to reliably locate such occurrences, and developing the techniques/technologies required to enable production.
- These challenges are being addressed through DOE and internationally supported research efforts.

Challenges still exist to fully understand the potential for, and implications of, gas production from hydrates.

- **Production Feasibility:** Methane hydrates occur in large quantities beneath the permafrost and offshore. DOE R&D is focused on determining the potential and environmental implications of production of natural gas from hydrates.
- **Research and Modeling:** DOE is studying innovative ways to predict the location and concentration of subsurface methane hydrate before drilling. DOE is also conducting studies to understand the physical properties of gas hydrate-bearing strata and to model this understanding at reservoir scale to predict future behavior and production.
- **International Collaboration**: International collaboration continues to be a vital part of the program since gas hydrates represent research challenges and resource potential that are important on a global scale.

Significance-

- Carbon Sequestration-Trapping carbon dioxide in hydrates can be a way to reduce to global warming in future. As one can sequester carbon dioxide gas as solid hydrates under the seabed.
- Sustainable Energy source-Development of technology to harvest Gas Hydrates can ensure energy security of the nation.
- Gas hydrate exploration in India-Under the aegis of the Ministry of Earth Sciences, Government of India, a comprehensive research-oriented gas hydrates program was launched during the 11th plan (2007-12) period emphasizing scientific and technology development with following major objectives:
- Understanding the nature of distribution of gas hydrates in marine sediments
- Developing techniques for detection and quantification of gas hydrates
- Identifying promising sites on the regional scale and estimating the resource potential
- Recommending suitable sites for drilling and ground truth validation
- Demonstrating occurrences of gas hydrates
- Understanding the mechanism for the formation and accumulation of gas hydrates
- Studying the impact of hydrate dissociation on climate and geological environment
- Developing environment-safe technology for commercial production on a pilot scale
- Developing hazardless and cost-effective transportation of gas from gas hydrates and
- Monitoring environmental perturbation during harvesting of gas hydrates
- National Centre For Polar And Ocean Research (NCAOR), Ministry of Earth Sciences has been identified as the nodal agency responsible for implementation of the scientific aspects of the study.
- National Gas Hydrate Programmes (NGHP)-The programme was initiated in 1997 with a Steering Committee and a Technical Committee.
- National Gas Hydrate Programme (NGHP) is steered by the Ministry of Petroleum and Natural Gas and technically coordinated by Directorate General of Hydrocarbons (DGH).

Conclusion

Gas hydrate deposits may contain roughly twice the carbon contained in all reserves of coal, oil, and conventional natural gas combined, making them a potentially valuable energy resource. Their decomposition can release large amounts of methane, which is a greenhouse gas that could impact Earth's climate.These gas hydrates could serve as a bridge to our energy future until cleaner fuel sources, such as hydrogen and solar energy, are more fully realized.

4. Examine the importance of soil as a natural resource. Discuss the factors that lead to soil depletion.

Approach

Candidates are expected to write about importance of the soil as a natural resources and then highlight different factors that are responsible for the soil depletion.

Introduction-

Soil is very important and a valuable resource for every human being. Soil is the mixture of rock debris and organic materials, which develop on the earth's surface. According to recently released Global Soil Biodiversity Atlas prepared by WWF India among nations that face grave danger to soil biodiversity.

Body

Soil as a resource:

- The fertile soil helps in the growth and development of the plants. The plants thus produced are healthy and provide food, clothing, furniture, and medicines.
- It supports many life forms including bacteria, fungi, algae, etc. These microbes, in turn, maintain environmental balance by retaining the moisture and decaying the dead organisms.
- The topsoil supports certain life activities such as reproduction, hatching, nesting, breeding, etc. of a few organisms.
- The organic matter present in the soil increases the fertility of the soil which is responsible for the growth of the plants. It also contains certain minerals and elements that are necessary for the plants to carry out their cellular activities.

Soil depletion:

- Soil depletion occurs when the components which contribute to fertility are removed and not replaced, and the conditions which support soil's fertility are not maintained. This leads to poor crop yields. In agriculture, depletion can be due to excessively intense cultivation and inadequate soil management.

The following factors can lead to accelerated soil depletion:

- Overgrazing: removal of grass by animals makes the top soil more susceptible to erosion.
- Deforestation: For mining activities, infrastructure building, loosed the soil and cause erosion.
- Improper farming techniques: Traditional methods of ploughing make water easier for running down causing erosion. Most of Indian agriculture consist of small and marginal farmers who use traditional methods.
- Economic activities: Soil depletion also occurs due to economic activities. The extraction of useful natural resources such as metals, minerals, and fossil fuels, etc., from the land causes serious disturbance to the land leading to soil erosion and drastic changes in the landscape.
- Loss of top soil by erosion: This is the removal of the topmost soil by either water or wind. When the topmost soil is taken away, it exposes the layer beneath for further loss, as nutrients are taken away as the topmost soil is removed.
- Nutrient Leaching: It is the leaching of nutrients deep down the soil by water draining down the soil. This leads to displacement of nutrients beyond the reach of roots of plants.
- Continuous cropping: It is the continuous cultivation of crops on the same piece of land without allowing the land to fallow. This over exploitation and excessive use of nutrients in the soil leads to their depletion eventually.
- Flooding and excessive irrigation: This leads to excessive water present on land. Excess water drains away nutrients from the soil rendering its deficient.
- Crop removal: some crops offer some form of protection for soil against soil erosion and evaporation which might otherwise lead to loss of soil nutrients and water.
- Decrease in organic matter content and soil bioactivity: The decreased levels of organic matter causes a strong reduction in soil fertility as it plays several roles in soil. The microbial activities in soil decrease due to reduced levels of organic matter. These microbial activities play significant role in nutrient availability and recycling. Decreased organic matter levels results in poor physical, chemical and biological properties.
- Soil acidification, salinization and alkalinization: Acidification, salinization or alkalinization causes reduction in soil fertility, and eventually lead to problems of nutrient deficiencies, toxicities and imbalances. Factors responsible for soil degradation are generally interrelated.
- Inefficient soil management: Poor or inefficient soil management results in decreased soil fertility. Improper crop rotations followed may decrease the

soil fertility tremendously. Excessive soil tillage leads to erosion of the soil which leads to reduced soil fertility.

- Soil pollution: Soil pollution caused by indiscriminate use of agro-chemicals and heavy metals reduces fertility of soil by affecting the soil biological properties. The growth of useful soil organisms is adversely affected which eventually causes a decline in biological soil fertility.

Conclusion

Soils are Degraded which threatens human livelihood and very existence. Thus, the need is to reverse the trend by sustainable soil management in agriculture, development and so on. There is a need to collaborate at state, national and international level.

5. What are lanthanides? Why are they so important? Briefly discuss their global distribution.

Approach

Question is straight forward. Candidate can define lanthanides, along with it importance of the same can be given along with its applications. In the end, their global distribution can be discussed.

Introduction

A lanthanide is one of a group of 15 elements that have atomic numbers 57 to 71. This is also known as the lanthanide series or lanthanoid series. This group starts at lanthanum and it ends at lutetium. Lanthanides are not abundant, and only small amounts are mined. Some have various uses in magnets, superconductors, chemical catalysts, and optical equipment such as lasers.

Body

Why are lanthanides important?

- Lanthanide elements and their compounds have many uses but the quantities consumed are relatively small in comparison to other elements.
- These minerals have unique magnetic, luminescent, and electrochemical properties and thus are used in many modern technologies, including consumer electronics, computers and networks, communications, health care, national defense, etc.
- Even futuristic technologies need these REEs (For example high-temperature superconductivity, safe storage and transport of hydrogen for a post-hydrocarbon economy, environmental global warming and energy efficiency issues).

- The devices lanthanide elements are used in include superconductors, samarium-cobalt and neodymium-iron-boron high-flux rare-earth magnets, magnesium alloys, electronic polishers, refining catalysts and hybrid car components (primarily batteries and magnets).
- Lanthanide ions are used as the active ions in luminescent materials used in optoelectronics applications, most notably the laser. Erbium-doped fiber amplifiers are significant devices in optical-fiber communication systems.
- Many defense-related products also use lanthanide elements such as night-vision goggles and rangefinders.
- Lanthanide oxides are mixed with tungsten to improve their high temperature properties for TIG welding, replacing thorium, which was mildly hazardous to work with.
- Most lanthanides are widely used in lasers, and as (co-)dopants in doped-fiber optical amplifiers; for example, in Er-doped fiber amplifiers, which are used as repeaters in the terrestrial and submarine fiber-optic transmission links that carry internet traffic.
- These elements deflect ultraviolet and infrared radiation and are commonly used in the production of sunglass lenses.
- Currently there is research showing that lanthanide elements can be used as anticancer agents. The main role of the lanthanides in these studies is to inhibit proliferation of the cancer cells. Specifically cerium and lanthanum have been studied for their role as anti-cancer agents.

Global distribution of lanthanides (rare earth metals)

- China has over time acquired global domination of rare earths, even at one point, it produced 90% of the rare earths the world needs.
- Today, however, it has come down to 60% and the remaining is produced by other countries, including the Quad (Australia, India, Japan and United States).
- Since 2010, when China curbed shipments of Rare Earths to Japan, the US, and Europe, production units have come up in Australia, and the US along with smaller units in Asia, Africa, and Latin America. Even so, the dominant share of processed Rare Earths lies with China.
- India has the world's fifth-largest reserves of rare earth elements, nearly twice as much as Australia, but it imports most of its rare earth needs in finished form from China.
- In 2019, the US imported 80% of its rare earth minerals from China while the European Union gets 98% of its supply from China.

India and rare earth metals

- India should create the new Department for Rare Earths (DRE) under the Ministry of Petroleum & Natural Gas which could secure access to Rare Earth Elements (REEs) of strategic importance by offering viability gap funding to companies to set up facilities in the upstream sector.
- This could make Indian Rare Earth Oxide (REOs) globally competitive.

- Alternatively, it could focus on downstream processes and applications, such as manufacturing rare earth magnets and batteries.
- This would require a focus on port infrastructure and ease of doing business measures to allow Indian manufacturers to import REOs from white-listed producers cheaply.
- Finally, it could coordinate with other agencies to partner directly with groupings such as the Quad, building up a strategic reserve as a buffer against global supply crises.

Conclusion

With adjustments to the existing policy, India could emerge as a rare earths supplier to the world and use these resources to power a high-end manufacturing economy geared to the needs of the 21st century.

1. Discuss the origin and features of the Deccan traps.

Approach

Candidates can start with giving basic information on deccan traps. Then candidates can write mode of eruption and origin and then simply explain its features with location.

Introduction

Deccan Traps have been defined as the greatest volcanic formation of the Indian subcontinent that consists of congealed lava flows covering an area of more than 400,000 square kilometers, with a thickness estimated at about 3000 metres.

Body

Mode of eruption:

- They were erupted in a sub-aerial environment (and not subaqueous, that is under water). This is suggested by their relation with the older rocks.
- Eruptions of the lava took place along linear fissures, forming fissure-type of eruption and not from any central cone-type volcanoes. This is explained by numerous flows and their remarkably consistent horizontal (or nearly so) attitude.
- The lava when erupted was in a highly liquid form, which is indicated by the long distances over which the individual flows could spread. This fact also suggests that the lava might have been super-heated to reach that state of mobility.

- A large number of dykes that have been found occurring intersecting many lava flows might be quite younger to those flows, but some such dykes might have also been the feeder dykes for the volcanic eruptions.
- The lava flows, especially after the beginning and before the close of activity, passed through definite periods of no volcanic activity. During such periods streams and lakes appeared on the cooled and congealed volcanic land forms here and there and both animal and plant life domiciled these areas. This is indicated by the occurrence of inter-trappean layers found in the lower and upper flows and their fossil contents.

Factors that led to origin of Deccan traps:

- Mantle plume: On the continents, mantle plumes have been responsible for extensive accumulations of flood basalts such as Deccan traps. Mantle plumes (few hundred kilometres in diameter) rise slowly towards the upper mantle. When a plume head encounters the base of the lithosphere, it flattens out and undergoes widespread decompression melting to form large volumes of basalt magma. The basaltic magma may then erupt onto the surface through a series of fissures giving rise to large igneous provinces. When created, these regions often occupy several thousand square kilometres.
- Plate tectonic: Most scientists believe that the Deccan Traps poured out as the Indian plate, on its northward journey after the Gondwana breakup, passed over the Reunion hotspot, a still active volcanic island located in the south-west Indian Ocean. Coeval with (or probably as a result of) this event, there was also a continental rift-drift between India and the Seychelles Islands. Indeed, flood basalts of similar age also occur on the Seychelles.
- Reunion Hotspot: The Reunion hotspot is a volcanic hotspot which currently lies under the Island of Reunion in the Indian Ocean. A huge eruption of this hotspot 66 million years ago is thought to have laid down the Deccan Traps and opened a rift which separated India from the Seychelles Plateau.
- Highly fluid lava: The lava when erupted was in a highly liquid form, which is indicated by the long distances over which the individual flows could spread. This fact also suggests that the lava might have been super-heated to reach that state of mobility.
- Linear fissures: Eruptions of the lava took place along linear fissures, forming fissure-type of eruption and not from any central cone-type volcanoes. This is explained by numerous flows and their remarkably consistent horizontal (or nearly so) attitude.
- Sub aerial environment: They were erupted in a sub-aerial environment (and not subaqueous, that is under water). This is suggested by their relation with the older rocks.
- Intersecting dykes: A large number of dykes that have been found occurring intersecting many lava flows might be quite younger to those flows, but some such dykes might have also been the feeder dykes for the volcanic eruptions.

- Seafloor spreading: Seafloor spreading at the boundary between the Indian and African Plates subsequently pushed India north over the plume, which now lies under Réunion island in the Indian Ocean, southwest of India.

Features:

- These volcanic rocks occupy greater parts of Kutch and Kathiawar in Gujarat and are also spread over Andhra Pradesh, Madhya Pradesh and Maharashtra. After the Archean Rocks, these (Deccan Traps) may be described as the most extensive geological formations of Peninsular India.
- It is largely called Black soil or regur soil. Owing to high proportion of clay content, they are sticky when wet and consequently difficult to plough. They develop under semi-arid conditions in the areas covered with basalt.
- Deccan trap are lava country, here humus is almost absent in the soil and the black color of the soil due to the present of titanium salt. They are rich in lime.
- The soil is moisture retentive and very productive especially in the low lands and in the river valleys where it is deep and clayey.
- In the high hills and on the slopes. These soils are generally thin, sandy and poor. Potash and nitrogen, so essential for rich plant growth and phosphorus which essential for grain crops, are not adequately present in these soils.

Conclusion

Deccan trap is one of the important formations in Indian stratigraphy. The lava erupted all along the fission crack in the surface of the earth intermittently. It is the store house for many minerals and black soil important for Indian agriculture therefore studying it can help in better understanding of Indian geological set up.

2. What are fluvial landforms? How are they formed? Discuss with the help of suitable examples.

Approach

Question is straight forward. Candidate can explain the fluvial landforms, their formation. With the help of suitable examples, fluvial landforms can be explained in detail.

Introduction

Fluvial landforms are those generated by running water, mainly rivers. The term fluvial derives from the Latin word 'fluvius' that means river. Fluvial Erosional Landforms are landforms created by the erosional activity of rivers. Fluvial landforms cover an enormous range of dimensions, from small features like rills to major continental-scale morpho-hydrological units like large rivers and their drainage basins.

Body

The landforms created as a result of degradation action (erosion) or aggradations work (deposition) of running water is called fluvial landforms. These landforms result from the action of surface flow/run-off or stream flow (water flowing through a channel under the influence of gravity).

Erosional landforms

River valleys

- The extended depression on ground through which a stream flows throughout its course is called a river valley. At different stages of the erosion cycle the valley acquires different profiles. At a young stage, the valley is deep, narrow with steep wall-like sides and a convex slope.
- The erosion action here is characterised by predominantly vertical down cutting nature. The profile of valley here is typically 'V' shaped. As the cycle attains maturity, the lateral erosion becomes prominent and the valley floor flattens out. The valley profile now becomes typically 'U' shaped with a broad base and a concave slope.
- A deep and narrow V shaped valley is also referred to as gorge and may result due to down cutting erosion and because of recession of a waterfall. Most Himalayan Rivers pass through deep gorges (at times more than 500 metres deep) before they descend to the plains. An extended form of gorge is called a canyon-E.g. Grand Canyon Colorado

Waterfalls

- A waterfall is simply the fall of an enormous volume of water from a great height, because of a variety of factors such as variation in the relative resistance of rocks, relative difference in topographic reliefs; fall in the sea level and related rejuvenation, earth movements etc. For example, Jog or Gersoppa falls on Sharavati (a tributary of Cauvery) has a fall of 260 metres.
- A rapid, on the other hand, is a sudden change in gradient of a river and resultant fall of water

Pot holes

- The kettle-like small depressions in the rocky beds of the river valleys are called pot holes which are usually cylindrical in shape. Pot holes are generally formed in coarse-grained rocks such as sandstones and granites.

Terraces

- Stepped benches along the river course in a flood plain are called terraces. Terraces represent the level of former valley floors and remnants of former (older) flood plains.

Gulley

- Gulley is an incised water- worn channel, which is particularly common in semi-arid areas. It is formed when water from overland-flows down a slope, especially following heavy rainfall, is concentrated into rills, which merge and enlarge into a gulley. The ravines of Chambal Valley in Central India and the Chos of Hoshiarpur in Punjab are examples of gulley.

Meanders

- A meander is defined as a pronounced curve or loop in the course of a river channel. The outer bend of the loop in a meander is characterised by intensive erosion and vertical cliffs and is called the cliff-slope side. This side has a concave slope. The inner side of the loop is characterised by deposition, a gentle convex slope, arid is called the slip-off side.

Oxbow lakes

- The outer curve of a meander gets accentuated to such an extent that the inner ends of the loop come close enough to get disconnected from the main channel and exist as independent water bodies. These water bodies are converted into swamps in due course of time. In the Indo-Gangetic plains, southwards shifting of Ganga has left many ox-bow lakes to the north of the present course of the Ganga.

Depositional landforms

Alluvial Fans and Cones

- When a stream leaves the mountains and comes down to the plains, its velocity decreases due to a lower gradient. As a result, it sheds a lot of material, which it had been carrying from the mountains, at the foothills. This deposited material acquires a conical shape and appears as a series of continuous fans. These are called alluvial fans. Such fans appear throughout the Himalayan foothills in the north Indian plains.

Natural leeves

- These are narrow ridges of low height on both sides of a river, formed due to deposition action of the stream, appearing as natural embankments. These act as a natural protection against floods but a breach in a levee causes sudden floods in adjoining areas, as it happens in the case of the Hwang Ho river of China.

Delta

- A delta is a tract of alluvium usually fan-shaped, at the mouth of a river where it deposits more material than can be carried away. The river gets divided into two or more channels (distributaries) which may further divide and rejoin to form a network of channels

3 What are rapids ? how are they different from waterfalls ? explain with the help of suitable examples .

Approach

A simple straightforward question where candidates need to write about rapids and waterfall . how rapid is different from waterfalls. explain this phenomenon with help of suitable examples .

Introduction

Rapids, and Waterfalls are most numerous in the mountain course where changes of gradient are more abrupt and also more frequent. Due to the unequal resistance of hard and soft rocks traversed by a river, the outcrop of a band of hard rock may cause river to 'jump' or 'fall' down-stream and Rapids are formed on the other side
When rivers plunge down in a sudden fall of some height, they are called Waterfalls.

Body

In the mountainous course, a river passes through a steep slope. Its water, therefore, rushes down with great speed. Under such a condition the water can dig the river bed very deeply and carries or pools down heavy boulders and pebbles. in this cource river males many landforms.

What is a rapid and what exactly is a waterfall?

- A rapid is a part of river where current is very fast because of relatively steep gradient of river bed at that place causing an increase in water flow and turbulence.
- It is the hydrological feature between a smoothly flowing part of a stream (run) and a sudden downpour (cascade).A waterfall is a permanent flow of water over the edge of an erosion-resistant cliff.
- It is a geological formation resulting from the sudden break in elevation or knickpoint of rock.

Formation of rapids vs waterfalls-

- A waterfall flowing over an erosion-resistant rock forms due to a sudden break in elevation or knickpoint.

- Streams become wider and shallow just above the waterfalls, and generally there deep pool at the place where water falls due to kinetic energy of the water hitting the bottom.
- A rapid forms due to shallowing of the river characterized by some rocks exposed above the water surface. These rocks are generally more erosion-resistant as compare to its neighborhood rocks beneath the water flow.

Creation factors for waterfalls vs rapids-

- Four factors, separately or in combination, can create rapids: gradient, constriction, obstruction, and flow rate. Gradient, constriction, and obstruction are streambed topography factors and are relatively consistent. Flow rate is dependent upon both seasonal variation in precipitation and snowmelt and upon release rates of upstream dams.
- On the other hand, when a river flows over a bed of rock that resists erosion, weaker rocks downstream are worn away, creating a steep, vertical drop and a plunge pool into which the water falls.
- This eroded rock and vertical drop and plunge pool are the factors influencing a Waterfall. Over time, continuing erosion causes the waterfall to retreat upstream forming a deep valley.

Examples of rapids and waterfalls-

Waterfalls are common in the mountains. This is due to the sudden and catastrophic change in stream course in hilly areas. It can also be because of water flowing over the same rock for many years and also sudden environmental changes like land slides, earthquakes, etc. Angel Falls in Venezuela is the highest waterfall in the World; Boyoma Falls has the largest volume of water (600,000 cubic feet per second); Victoria Falls is the widest in the World. Violent water below Niagara Falls is one of the examples of a rapid. The Des Moines Rapids is one of two major rapids on the Mississippi River

Waterfalls:

A waterfall is simply the fall of an enormous volume of water from a great height, because of a variety of factors such as variation in the relative resistance of rocks, relative difference in topographic reliefs; fall in the sea level and related rejuvenation, earth movements etc. For example, Jog or Gersoppa falls on Sharavati (a tributary of Cauvery) has a fall of 260 metres.

A rapid, on the other hand, is a sudden change in gradient of a river and resultant fall of water.

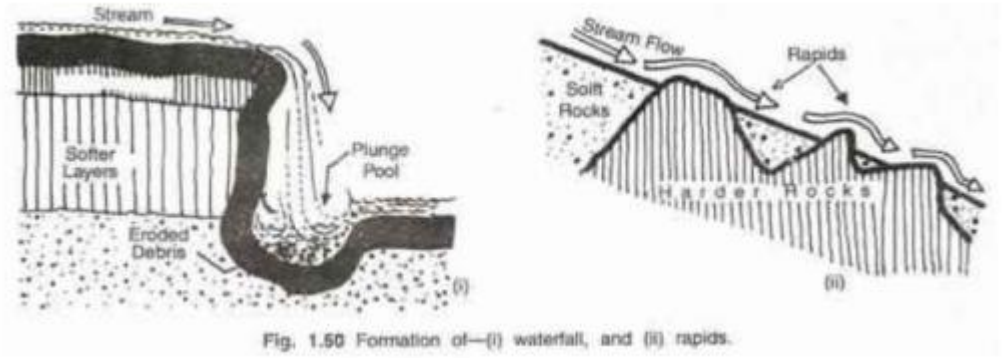


Fig. 1.50 Formation of—(i) waterfall, and (ii) rapids.

Conclusion

India has many rivers at the youthful stage originating in Himalayas. The evolution of various landforms due to the high pace of rivers has its impacts on the geography, economy and people. With climate change, the rate of melting of glaciers is high leading to changes in river water flow. Thus, it is imperative to understand the river geomorphology.

4. Describe the location of the Pacific Ring of Fire. Also, discuss its origin and characteristics.

Approach

Candidates are expected to write about pacific ring of fire introduction and then highlight on its location. Also try to discuss its origin with explaining the subduction zone then simply write about its characteristics.

Introduction-

The Pacific rim, also known as the Circum-Pacific Belt, is a region of the Pacific Ocean characterized by active volcanoes and frequent earthquakes. It is home to approximately 75% of the world's volcanoes over 450 volcanoes. In addition, approximately 90% of the world's earthquakes occur here.

Body

Location:

- It stretches along the Pacific Ocean coastlines, where the Pacific Plate grinds against other, smaller tectonic plates that form the Earth's crust – such as the

Philippine Sea plate and the Cocos and Nazca Plates that line the edge of the Pacific Ocean.

- The 40,0000-kilometre horse-shoe-shaped ring loops from New Zealand to Chile, passing through the coasts of Asia and the Americas on the way.
- The Ring of Fire stretches for about 40,000 kilometers, tracing the boundaries of several tectonic plates such as the Pacific, Juan de Fuca, Cocos, Nazca, Indian-Australian, North American, and Philippine Plates.
- The chain runs up the western coasts of South and North America, across the Aleutian Islands in Alaska, down the eastern coast of Asia past New Zealand, and into Antarctica's northern coast.
- Bolivia, Chile, Ecuador, Peru, Costa Rica, Guatemala, Mexico, the United States, Canada, Russia, Japan, the Philippines, Papua New Guinea, Australia, Indonesia, New Zealand, and Antarctica are some of the important places located in the ring of fire.
- Indonesia sits along the Ring of Fire region, an area where most of the world's volcanic eruptions occur. The Ring of Fire has seen a large amount of activity in recent days, but Indonesia has been hit hard due to its position on a large grid of tectonic plates.

Origin:

- The Ring of Fire is the result from subduction of oceanic tectonic plates beneath lighter continental plates. The area where these tectonic plates meet is called a subduction zone.
- Subduction zones are formed when tectonic plates move towards each other. The other plate pushes down or subducts one plate. This is a very slow process, with only one or two inches of movement per year.
- Pacific Plate and North American Plate converge where pacific plate subducts under North Americal plate – This convergent plate boundary continues to form Aleutian islands (Hosts 27 Active Volcanoes)and Aleutian Trench.
- Nazca Plate and South American Plate converge where Nazca plate subducts beneath the South American tectonic plate. This convergence created Andes Mountain and Peru-Chile trench. Nevados Ojos del Salado which is the world's highest active volcano
- As a result of this subduction, rocks melt, become magma, and move to the Earth's surface, causing volcanic activity.
- In the case of Tonga, the Pacific Plate was pushed beneath the Indo-Australian Plate and the Tonga Plate, causing molten rock to rise above and form the chain of volcanoes.

Characteristics-Features:

Trenches:

- Ocean trenches are steep depressions in the deepest parts of the ocean where an old ocean crust from one tectonic plate is pushed beneath another plate,

raising mountains, causing earthquakes, and forming volcanoes on the seafloor and on land.

- The ring of fire is home to the deepest ocean trench, called the Mariana Trench. It is a 7-mile-deep trench.
- Other trenches in the region are: Philippine Trench, Challenger trench, Kuril-Kamchatka Trench, Peru–Chile Trench and Tonga Trench.

Island Arcs:

- They are long, curved chains of oceanic islands associated with intense volcanic and seismic activity and orogenic (mountain-building) processes.
- An island arc typically has a land mass or a partially enclosed, unusually shallow sea on its concave side.
- Along the convex side there almost invariably exists a long, narrow deep-sea trench.
- The greatest ocean depths are found in these depressions of the seafloor, as in the case of the Mariana (deepest trench in the world) and Tonga trenches.
- Prime examples of this form of geologic feature include the Aleutian-Alaska Arc and the Kuril-Kamchatka Arc.

Earthquakes:

- 90% of earthquakes occur along its path, including the planet's most violent and dramatic seismic events.
- The Ring of Fire has been the setting for the most devastating earthquakes in recorded history, including the Chile earthquake of 1960 and 2010, the Alaska earthquake of 1964, and the Japan earthquake of 2011 as well as the earthquake that produced the devastating Indian Ocean tsunami of 2004.
- The Valdivia Earthquake of Chile, occurred in 1960, was the strongest recorded earthquake at 9.5 out of 10 on the Richter scale.

Volcanoes in it

- The Ring of Fire contains approximately 850–1,000 volcanoes that have been active during the last 11,700 years (about two-thirds of the world's total).

The four largest volcanic eruptions on Earth in the last 11,700 years occurred at volcanoes in the Ring of Fire.

- More than 350 of the Ring of Fire's volcanoes have been active in historical times

Conclusion

The people most at risk from activity in the Ring of Fire are in the US west coast, Chile, Japan and island nations including the Solomon Islands. These areas are most at risk because they lie on so-called subduction zones which are boundaries that mark the collision between two of the planet's tectonic plates.

5. Discuss the distribution of lakes in North America. How do these lakes contribute to the economy? Examine.

Approach

Candidate can describe the great lakes in north America, their detail description can be given in the first part. In the second part, their significance for the local and international economy can be stated.

Introduction

The Great Lakes are, from west to east: Superior, Michigan, Huron, Erie and Ontario. They are a dominant part of the physical and cultural heritage of North America. Shared with Canada and spanning more than 750 miles (1,200 kilometers) from west to east, these vast inland freshwater seas provide water for consumption, transportation, power, recreation and a host of other uses. The Great Lakes are one of the world's largest surface freshwater ecosystems.

Body

Lakes in north America

- Great Lakes, chain of deep freshwater lakes in east-central North America comprising Lakes Superior, Michigan, Huron, Erie, and Ontario. They are one of the great natural features of the continent and of the Earth.
- Although Lake Baikal in Russia has a larger volume of water, the combined area of the Great Lakes—some 94,250 square miles (244,106 square kilometres)—represents the largest surface of fresh water in the world, covering an area exceeding that of the United Kingdom.
- Their drainage basin of about 295,710 square miles (which includes the areas of the lakes themselves and their connecting waterways) extends approximately 690 miles from north to south and about 860 miles from Lake Superior in the west to Lake Ontario in the east.

- Except for Lake Michigan, the lakes provide a natural border between Canada and the United States, a frontier that was stabilized by a boundary-waters treaty of 1909.

- The age of the Great Lakes is still not definitely determined. Estimates range from 7,000 to 32,000 years of age. Water began filling the glacially scoured basins as soon as the ice receded, some 14,000 years ago.
- The present configuration of the Great Lakes basin is the result of the movement of massive glaciers through the mid-continent, a process that began about one million years ago during the Pleistocene Epoch.

Economy of great lakes

- The Great Lakes Region has always been a center of trade. From the fur trade of the 17th century to modern day, the area's navigable terrain, waterways, and ports have made it an easy place for goods to exchange hands.
- The Great Lakes Region includes eight states (Minnesota, Wisconsin, Illinois, Indiana, Michigan, New York, Ohio, and Pennsylvania) and two Canadian provinces (Ontario and Quebec) that surround the five interconnected freshwater bodies known as the Great Lakes.
- he area is home to 107 million people, 51 million jobs, and a GDP of US$6 trillion – making the Great Lakes Economy a powerhouse on an international level.
- In particular, the region is well-known globally for its manufacturing prowess. It's home to automobile and aerospace giants like Ford, GM, Chrysler, Bombardier, GE Aviation, and Magna International, and also many other diverse industries.
- Education and health, shipping and logistics, agriculture, mining and energy, tourism, and finance are some of the other major industries that generate business for the region.
- And despite having a border, the Great Lakes Economy is highly integrated. Each year, there is $278 billion in bilateral U.S.-Canadian trade in the Great Lakes area – more than the entire region trades with countries like Mexico, China, UK, Germany and Japan combined.
- For U.S. companies in the region, 78% of the imports they bring in from Canada are "intermediate goods", which are raw materials, parts and components, and services that are used to produce other goods and services in the United States.
- Going the other way, Canadians buy billions of dollars worth of goods from the Great Lake states as well. In fact, Canada is actually the biggest international customer for each state in the region.

Conclusion

In this region, Each day, close to 10,000 trucks pass to generate close to US$500 million of international trade between the two nations. That's equal to 25% of all bilateral trade between Canada and the U.S. Amazingly, more bilateral trade happens over this single bridge than the U.S. does in its entirety with France, Germany, South Korea, or the United Kingdom.