1. What are different weather phenomena associated with low pressure systems? Discuss.

Approach:

It is strait forward question where it expects students to write various weather phenomena associated with low pressure system.

Introduction:

A low pressure system is a large mass of air that is rising due to warmer land or water below it. The air becomes hot and starts to expand, becoming less dense. When there is also moisture in the air mass, it will weigh less due to the water vapour whose molecules are lighter than air molecules. The end result is wet, less dense air that rises and begins to cool in the upper atmosphere.

Body:

Different weather phenomena associated with low pressure systems:

- Wind is initially accelerated from areas of high pressure to areas of low pressure. This is due to density (or temperature and moisture) differences between two air masses. Since stronger high-pressure systems contain cooler or drier air, the air mass is denser and flows towards areas that are warm or moist, which are in the vicinity of low-pressure areas in advance of their associated cold fronts.
- The stronger the pressure difference, or pressure gradient, between a high-pressure system and a low-pressure system, the stronger the wind. Thus, stronger areas of low pressure are associated with stronger winds.
- The Coriolis force caused by the Earth's rotation is what gives winds around low-pressure areas (such as in hurricanes, cyclones, and typhoons) their counter-clockwise (anticlockwise) circulation in the northern hemisphere (as the wind moves inward and is deflected right from the centre of high pressure) and clockwise circulation in the southern hemisphere (as the wind moves inward and is deflected left from the centre of high pressure).
- Thermal lows form due to localized heating caused by greater sunshine over deserts and other land masses. Since localized areas of warm air are less dense than their surroundings, this warmer air rises, which lowers atmospheric pressure near that portion of the Earth's surface. Large-scale thermal lows over continents help drive monsoon circulations.
- Low-pressure areas can also form due to organized thunderstorm activity over warm water. When this occurs over the tropics in concert with the Intertropical Convergence Zone, it is known as a monsoon trough.
- Monsoon troughs reach their northerly extent in August and their southerly extent in February. When a convective low acquires a well-hot circulation in the tropics it is termed a tropical cyclone. Tropical cyclones can form during any month of the year globally, but can occur in either the northern or southern hemisphere during December.

- Atmospheric lift will also generally produce cloud cover through adiabatic cooling once the air becomes saturated as it rises, although the low-pressure area typically brings cloudy skies, which act to minimize diurnal temperature extremes. Since clouds reflect sunlight, incoming shortwave solar radiation decreases, which causes lower temperatures during the day.
- At night the absorptive effect of clouds on outgoing longwave radiation, such as heat energy from the surface, allows for warmer diurnal low temperatures in all seasons. The stronger the area of low pressure, the stronger the winds experienced in its vicinity.

Conclusion:

Low pressure conditions create phenomenon that widely affects the life and agriculture of people affecting economies of country in both productive and destructive way.

2. Why are some parts of India are highly prone to earthquakes? Explain.

Approach:

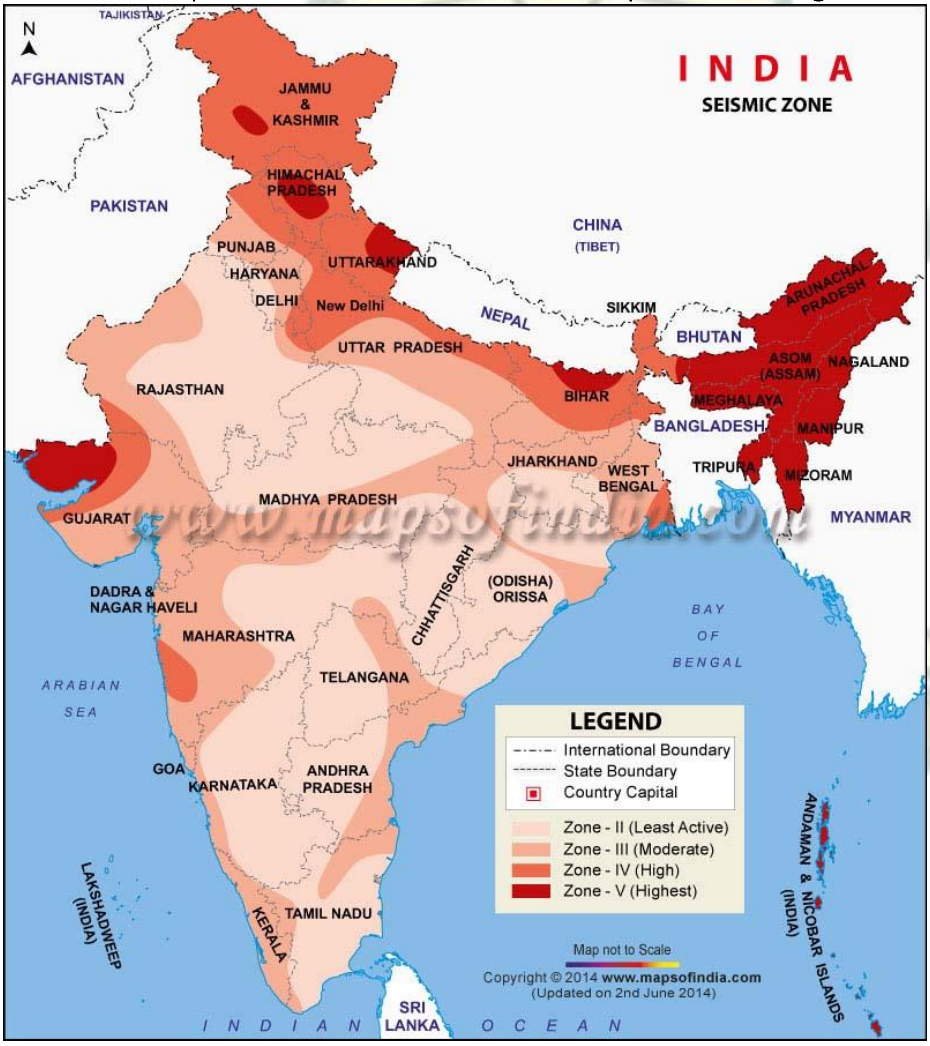
It expects aspirants to write reason behind frequent earthquake in some part of India. You can also draw map to show high earthquakes occurring region.

Introduction:

Earthquakes are caused due to tectonic shifts below the earth surface. India's case is quite serious as the Indian subcontinental plate grinds against the Asian continental plate. India cities, particularly towards the north and closer to the Himalayas, face a bigger threat.

Body:

Due to the country's topography, it is important to classify the regions into seismic zones with respect to the likelihood of an earthquake occurring in the region:



- The Bureau of Indian Standards has classified regions in India into four seismic zones on the basis of historical seismic activity. Zone-2, zone-3, zone-4 and zone five. Of these, the least threatened is Zone 2 and the highest risked is Zone-5. All the states of North-East, Jammu and Kashmir, Uttarakhand and parts of Himachal Pradesh fall under Zone-5. Delhi falls in Zone-4, central India falls under relatively low danger zone of Zone-3, while most of the south falls in Zone-2 with limited danger, but it is a thicker classification.

- There are some areas in Delhi which can be as dangerous as Zone-5. Thus, there may be many places in the south states which may be hazardous like zone-4 or zone-5. Other Zone-5 may also have some areas where earthquake risk is very low and they are less hazardous like Zone-2.

Reasons why some regions are prone to Earthquakes in India: -

North east:

- The geological stress in the Northeast's hills, due partly to frequent tremor-driven weakening of the Himalayas, and the colliding of the Himalayan plate with the Indo-Burmese plate, has put the entire region on high alert.
- Most earthquakes occurring in the region are related to subduction of the India-Burma tectonic plate under the Java-Sumatra tectonic plate.

North India:

- North India is located near boundary between the Eurasian and Indo-Australian plate tectonics. Obviously, there's immense pressure where these two plates meet. Every once in a while, the stress releases in the form of vibrations.
- Besides, seismologists feel that the tectonic plates west of the epicentre of the recent Nepal earthquake are still locked, indicating that another trigger is about to go off.

Peninsular India:

- The general understanding of earthquakes in Peninsular India is that the Precambrian terrain is heterogeneous in strength, criss-crossed with rifts, shear zones and old orogenic belts and these ancient zones of weak crust get reactivated from time to time and rupture.
- When Indian and Eurasian plates collided because of intense pressure the peninsula has up warped in many places. The ancient rifts that had crisscrossed the nations subsurface strata are suddenly being activated.

Conclusion:

The threat is as real as it gets and preparedness is the only solution to avert something that is beyond human control. Although none of the metropolises have been hit by major quake in India recently, the potential devastation it could cause is catastrophic.

3. Discuss various geophysical phenomena associated with plate tectonics.

Approach:

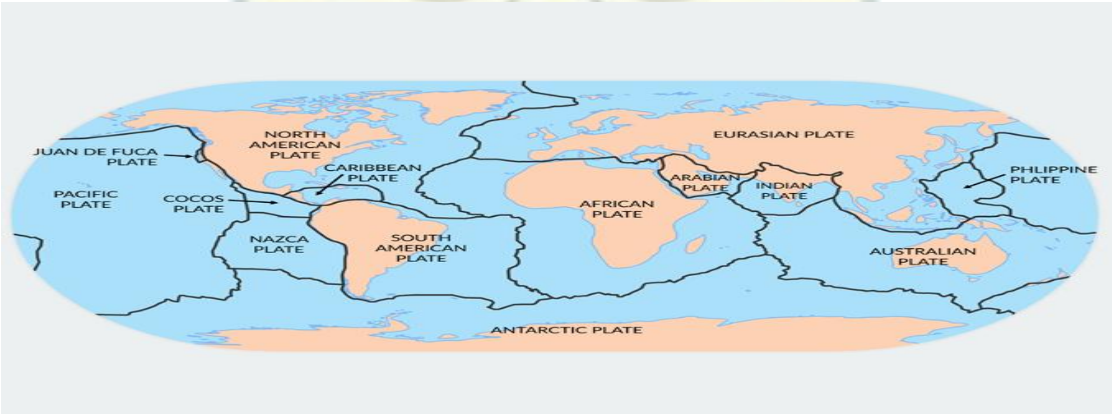
As directive here is discuss, it is required to cover various angles related to the topic. In the introduction explain what is plate tectonics. In the main body part explain various geophysical phenomena associated with plate tectonics. You can conclude by explaining the role played by plate tectonics in shaping the different physical features on the earth.

Introduction:

Plate tectonics, is a scientific theory describing the large-scale motion of seven large plates and the movements of a larger number of smaller plates of Earth's lithosphere, since tectonic processes began on Earth between 3.3 and 3.5 billion years ago.

Body:

Almost all major landforms formed are due to plate tectonics. Following Map 1 represents major and minor tectonic plates:



Map 1: Major Tectonic Plates on Earth

Different kinds of geophysical phenomena occur due to different kind of plate boundary movements. Following Figure 1 represents different kinds of plate boundary movements.

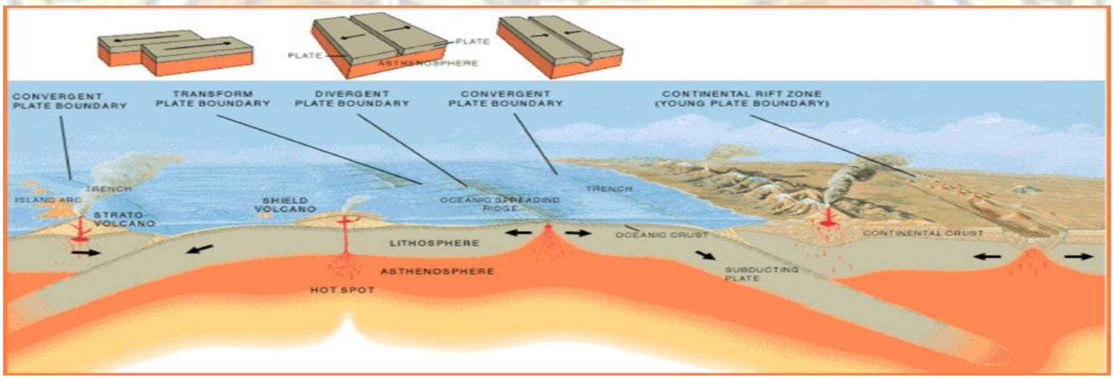


Figure 1: Different kinds of plate boundary movements

Various geophysical phenomena associated with plate tectonics:

- Fold Mountains: The compressional forces stemming from a convergent plate boundary, where two plates collide with one another, can create fold mountains. This may involve the collision of two continental plates or a continental plate and oceanic plate, forcing sedimentary rocks upwards into a series of folds.
- Fold mountains usually form along the edges of continents, because these margins tend to accumulate the greatest sedimentary deposits. When tectonic plates collide, layers of accumulated rock crumple and fold. For instance, the Appalachians and Urals are examples of fold mountains.
- Ocean Trenches: Ocean trenches form at two kinds of convergent plate boundaries: where a continental and oceanic plate converge, or where two oceanic plates converge.
- Oceanic plates are denser than continental plates and so plunge beneath them, or "subducts"; at an oceanic/oceanic boundary, whichever plate is denser – the older, cooler plate – subducts beneath the other.
- In both cases, the subduction forms an undersea trench. These trenches are long, narrow valleys and include the deepest areas of the ocean. The deepest ocean trench is the Marianas Trench, reaching a depth of almost 36,000 feet below sea level.
- Ocean Ridges: At divergent boundaries, plates move away from each other, creating a new crust as magma is pushed up from the mantle. Mid-ocean ridges result from volcanic swelling and eruptions along the divergent boundary. The Mid-Atlantic Ridge serves as a well-known example.
- Volcano: Most volcanoes form at the boundaries of Earth's tectonic plates. ... At a divergent boundary, tectonic plates move apart from one another. They never really separate because magma continuously moves up from the mantle into this boundary, building new plate material on both sides of the plate boundary.
- Island Arcs: The subduction process that occurs when an oceanic plate converges with another oceanic plate can lead to volcanoes being formed paralleling the trench.
- The volcanic debris and lava build up on the ocean floor over millions of years and eventually results in a formerly submarine volcano rising above sea level to create an island. A curved chain of these volcanoes, known as an island arc, usually occurs in these cases.
- Earthquakes: Earthquakes occur along fault lines, cracks in Earth's crust where tectonic plates meet. They occur where plates are sub ducting, spreading, slipping, or colliding. As the plates grind together, they get stuck and pressure builds up. Finally, the pressure between the plates is so great that they break loose.

Conclusion:

Plate tectonics, theory dealing with the dynamics of Earth's outer shell-the lithosphere-that revolutionized Earth sciences by providing a uniform context for understanding mountain-building processes, volcanoes, and earthquakes as well as the evolution of Earth's surface and reconstructing its past continents and oceans. Further progress in understanding the process of plate tectonics will definitely help to realise any threat posed by earthquake like phenomena and will surely provide a way out to face these kind of calamities in future.

4. How do activities associated with the solar surface affect the earth? Illustrate.

Approach - It expects students to write about solar surface and how does it affect the earth with illustrations.

Introduction

The Sun is a sphere, composed almost entirely of the elements hydrogen and helium. It's not solid or a typical gas. Most atoms in the Sun exist as plasma, a fourth state of matter made up of superheated gas with a positive electrical charge. It is a constant in all our lives. It provides the daily rhythm of sunrises and sunsets, and it's vital to all life on Earth. The Sun's heat passes through its surface, and in turn heats the surface of the Earth.

Body

Solar surface - The surface of the Sun, the photosphere, is a 500-kilometre-thick region, from which most of the Sun's radiation escapes outward. This is not a solid surface like the surfaces of planets. Instead, this is the outer layer of the gassy star. We see radiation from the photosphere as sunlight when it reaches Earth about eight minutes after it leaves the Sun.

Activities associated with solar surface affecting earth:

- Impacts of Solar flares: Solar flares release a lot of radiation into space. Solar flares, when powerful enough, can disrupt satellite and radio transmission on the Earth, and more severe ones can cause 'geomagnetic storms' that can damage transformers in power grids.
- Coronal Mass Ejection (CME): They can trigger intense light in the sky on Earth, called auroras. Some of the energy and small particles travel down the magnetic field lines at the north and south poles into Earth's atmosphere. There, the particles interact with gases Oxygen gives off green and red light. Nitrogen glows blue and purple. The aurora in Earth's northern atmosphere is called an aurora borealis or northern lights. It's southern counterpart is called an aurora australis or the southern lights.
- Impacts of Solar Cycle: Solar Cycle activity can affect satellite electronics and limit their lifetime. Radiation can be dangerous for astronauts who do work on the outside of the International Space Station. Forecasting of the solar cycle can help scientists protect our radio communications on Earth, and help keep satellites and astronauts safe.
- Solar wind: Solar wind from coronal holes will temporarily create disturbances in the Earth's magnetosphere, called geomagnetic storms, auroras, and disruptions to communications and navigation systems.
- Solar minima and maxima: They are the two extremes of the Sun's 11-year and 400-year activity cycle. Due to solar maxima sky watchers may see more auroras, and space agencies must monitor radiation storms for astronaut protection. Power outages, satellite malfunctions, communication disruptions,

and GPS receiver malfunctions are just a few of the things that can happen during a solar maximum. The space weather during solar minimum will also affect Earth's upper atmosphere on satellites in low Earth orbit changes. This means that the Earth's upper atmosphere will cool down which is generally heated and puffed up by ultraviolet radiation from the sun.

- Solar storms: Solar storms are a variety of eruptions of mass and energy from the solar surface. Solar storms have the potential to modify geomagnetic field and disrupt magnetic orientation behaviour of animals, hampering their navigation during long periods of migration. They disrupt earth's magnetic field and the whales' navigational sense. The radio frequency noise created by the solar outburst affects the whales' senses in a way that prevents them from navigating at all.

Some real-world examples of impacts?

- September 2, 1859, disruption of telegraph service.
- One of the best-known examples of space weather events is the collapse of the Hydro-Québec power network on March 13, 1989 due to geomagnetically induced currents (GICs). Caused by a transformer failure, this event led to a general blackout that lasted more than 9 hours and affected over 6 million people. The geomagnetic storm causing this event was itself the result of a CME ejected from the sun on March 9, 1989.

India's first solar mission, Aditya-L1 satellite will aim to measure the solar surface activities and coronal magnetic fields regularly. This will help understand the spectacular solar eruptions and predictions of space weather and many more things.

Conclusion

The sun is the only star we can study up close. By studying this star we live with, we learn more about stars throughout the universe. The sun is a source of light and heat for life on Earth. The more we know about it, the more we can understand how life on Earth developed. As we send spacecraft and astronauts further and further from home, we must understand this space environment just as early seafarers needed to understand the ocean.

5. With the help of suitable examples, discuss the landforms associated with vulcanism.

Approach:

Students are expected to write about the landforms associated with vulcanism and give suitable examples.

Introduction:

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 and this process is called Vulcanism. Molten magma is mobile rock that forces its way in to the planes of the crust to escape quietly or explosively to the surface. The resultant landforms depend on the strength and fluidity of the magma.

Body:

Volcanic landforms are divided into extrusive and intrusive landforms based on whether magma cools within the crust or above the crust.

Intrusive Volcanic Landforms: Intrusive landforms are formed when magma cools within the crust.

- Sills: When an intrusion of molten magma is made horizontally along the bedding plane of sedimentary rocks, these solidified horizontal lava layers inside the earth called sill. Example - Great whin sill of NE England.
- Dykes: When an intrusion of molten magma injected vertically as narrow wall of igneous rocks such structures are called dykes. Lava makes its way through cracks and the fissures developed in the land, it solidifies almost perpendicular to the ground and It gets cooled in the same position. Example- Cleveland Dyke of Yorkshire, England.
- Laccoliths: It is a large blister or igneous mound with dome-shaped upper surface and a level base fed by a pipe-like conduit from below.it arches up the overlying strata of sedimentary rocks. Example- The laccoliths of Henry mountains in the Utah, USA.
- Lopolith: When the lava moves upwards, some portion of the lava may tend to move in a horizontal direction in weak plane. In case it develops into a saucer shape, concave to the sky body, it is called Lopolith. Example- The Bushveld lopolith of Transvaal, South Africa.
- Phacolith: It is a lens-shaped mass of intrusive rocks, at times, is found at the base of synclines or at the top of anticline in folded igneous country. This material has conduit from beneath for the source. Example- Corndon hill in Shropshire, England.
- 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 forms a massive and resistant upland region. Example- Wicklow mountains of Ireland; the uplands of Brittany, France.

Extrusive Volcanic Landforms: Magma that reach on the surface and solidify forms extrusive landforms

- Conical Vent and Fissure Vent: A conical vent is a narrow cylindrical vent through which magma flows out violently. Conical vents are common in andesitic (composite or strato volcano) volcanism.
- 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, Mt. Stromboli (Lighthouse of the Mediterranean) etc.
- 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).
- 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- Snake Basin, U.S.A, Icelandic Shield, Canadian Shield etc.
- Cinder cone (Tephra cones): Cinder cones are small volume cones consisting predominantly of tephra that result from strombolian eruptions. They usually consist of basaltic to andesitic material. Example- Mt. Paricutin, Mexico.
- Crater: A crater is an inverted cone-shaped vent through which the magma flows out. When the volcano is not active the crater appears as a bowl-shaped depression. Example- The crater of Mount Fuji, Japan
- 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.
- 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 and it cools slowly and flows through longer distances. It may responsible for sea floor spreading. Example- Mid-Atlantic Ocean ridge; extension is seen in the Iceland.

Conclusion:

Volcanic activities have profound influence on earth's landforms as volcanic processes are constantly changing the Earth. Solid, liquid or gaseous materials may find their way to the surface from some deep-seated reservoir beneath. Eruptions can create new islands, build and destroy mountains, and alter landscapes.