VISHNU IAS
MODERN GURUKUL FOR CIVIL SERVICES
TGPSC G 1 | UPSC - CSE | APPSC G 1

PRELIMS PYQS PROGRAM
2013 TO 2026
DAY – 01: GEOGRAPHY
EXPLANATIONS

Q1. Answer: (a)

Detailed Explanation :

Why this question asked in 2018 ? :

- UN Chief Visit (June 2017)
- Green Belt Project (2017)
- Historic Salt Storm (2018)

Statement 1: Aral Sea – Correct

Location: Central Asia, between Kazakhstan and Uzbekistan.

Status: One of the world's most prominent examples of human-induced environmental degradation.

- The Aral Sea was once the ***world's fourth-largest inland lake***.
- During the Soviet period, particularly from the 1960s, the **Amu Darya** and **Syr Darya** rivers were extensively ***diverted for irrigation***.
- These rivers were the principal sources of water for the Aral Sea.
- Large-scale cotton cultivation and inefficient irrigation systems **reduced the inflow** of freshwater.
- Consequently, the sea experienced a dramatic ***reduction*** in its surface area and volume.
- Its exposed seabed generated salt- and pesticide-laden dust, affecting human health, agriculture and local ecosystems.

Statement 2: Black Sea – Incorrect

Location: Between Eastern Europe and Western Asia.

Surrounding countries: Turkey, Bulgaria, Romania, Ukraine, Russia and Georgia.

- The Black Sea is a large inland marine water body ***connected to*** the Mediterranean Sea through the Bosporus Strait, Sea of Marmara and Dardanelles.

- It ***receives freshwater*** from major rivers such as the Danube, Dnieper and Don.
- It faces serious environmental problems, including:
    - Industrial and agricultural pollution.
    - Eutrophication due to excessive nutrient inflow.
    - Oxygen depletion (anoxic conditions) in deeper waters.
- However, these environmental problems have ***not resulted in*** immense shrinkage or drying up of the Black Sea.

Statement 3: Lake Baikal – Incorrect

Location: Southern Siberia, Russia.

Status: World's deepest freshwater lake and largest freshwater lake by volume.

- Lake Baikal is approximately ***1,642 metres deep***.
- It contains around 20% of the world's unfrozen surface freshwater.
- It is a **UNESCO World Heritage Site** (1996).
- It faces environmental threats such as:
    - Industrial and domestic pollution.
    - Climate change and rising water temperatures.
    - Ecological disturbances affecting endemic species, including the Baikal seal (Pusa sibirica).
- Its water levels have experienced fluctuations, but it has ***not undergone*** immense human-induced shrinkage or drying up comparable to the Aral Sea.

Major Shrinking Water Bodies in world :

- **Aral Sea** – Location: Kazakhstan–Uzbekistan; Major reason: Diversion of rivers for irrigation
- **Lake Chad** – Location: Chad, Niger, Nigeria, Cameroon region; Major reason: Water diversion, drought and climate variability
- **Lake Urmia** – Location: Iran; Major reason: Dam construction, irrigation and drought
- **Dead Sea** – Location: Israel–Jordan region; Major reason: Reduced inflow from Jordan River and mineral extraction
- **Owens Lake** – Location: California, USA; Major reason: Diversion of water to Los Angeles

Q2. Answer: (d)

Detailed Explanation :

(a) Bhitarkanika Mangroves – Incorrect

Location: Kendrapara district, Odisha.

Type: Deltaic mangrove ecosystem.

- Located in the deltaic region of the **Brahmani and Baitarani rivers.**
- Formed primarily through ***riverine sediment deposition*** under tidal influence.
- Characterised by *mangrove vegetation, tidal creeks, mudflats and estuarine habitats*.
- Famous for its **saltwater crocodiles (***Crocodylus porosus*).
- Its formation is associated primarily with ***delta development and tidal processes***, rather than repeated sea-level falls exposing a vast marine basin.

(b) Marakkanam Salt Pans – Incorrect

Location: Villupuram district, Tamil Nadu.

Type: Coastal salt-production area.

- Marakkanam is known for ***extensive salt production*** along the Coromandel Coast.
- Salt is produced by allowing seawater or saline water to evaporate in shallow artificial ponds.
- Solar evaporation causes **salt crystallisation**.
- These salt pans are primarily ***human-managed salt-production units***, not a natural geomorphological landform created by repeated sea-level regression.

(c) Naupada Swamp – Incorrect

Location: Srikakulam district, Andhra Pradesh.

Type: Coastal swamp and wetland.

- Naupada is a ***coastal wetland region*** associated with marshy terrain and saline conditions.
- It is also known for salt production and wetland ecosystems.
- Its existence as a swamp *does not establish* that it was formed by repeated falls in sea level.

(d) Rann of Kutch – Correct

Location: Gujarat, north-western India.

Type: Extensive seasonal saline marshland.

- The Rann of Kutch was historically connected with the Arabian Sea and formed part of a shallow marine environment.
- Geological changes, including tectonic movements and ***repeated fluctuations*** in relative sea level, contributed to its emergence and transformation.

- Repeated marine regressions **exposed** previously submerged areas.
- Sediment deposition and the development of low-lying saline terrain contributed to its present geomorphology.
- It is broadly divided into:
    1. Great Rann of Kutch
    2. Little Rann of Kutch

Seasonal characteristics:

- Monsoon: Large parts become inundated by shallow water.
- Summer: Water evaporates, leaving behind extensive salt-encrusted flats.

Q3. Answer: (b)

Detailed Explanation :

Statement I: Scientific studies suggest that a shift is taking place in Earth's rotation and axis.

Correct

- Earth's axis of rotation is ***not perfectly fixed*** in space or relative to its surface.
- Its orientation and position undergo small changes due to the **redistribution of mass** within and across the Earth.
- These changes are collectively associated with polar motion and variations in Earth's rotation.
- Earth's **rotational speed** can also change slightly, ***affecting the length of a day***.
- Factors responsible include:
    1. Melting of polar ice sheets and glaciers.
    2. Changes in ocean circulation and water distribution.
    3. Atmospheric circulation and wind patterns.
    4. Movements within Earth's mantle and core.

Statement II: Solar flares and associated coronal mass ejections bombarded Earth's outermost atmosphere with tremendous amounts of energy.

Correct statement, but does not explain Statement I

Understand the two terms:

1. Solar flares: Sudden, intense bursts of electromagnetic radiation released from the Sun's atmosphere.
2. Coronal Mass Ejections (CMEs): Large expulsions of magnetised plasma and charged particles from the Sun's corona into space.

What happens when they reach Earth?

- They interact with Earth's magnetosphere and upper atmosphere.
- They can produce geomagnetic ***storms and auroras***.
- They ***can disturb*** radio communications, GPS signals and satellite operations.
- They deposit energy into Earth's upper atmosphere, particularly the thermosphere and ionosphere.

Important distinction:

Although solar flares and CMEs **transfer enormous energy** to Earth's outer atmosphere, ***they do not cause the significant redistribution of Earth's mass*** responsible for the observed long-term shift in its rotational axis.

Statement III: As Earth's polar ice melts, the water tends to move towards the equator.

Correct statement and explains Statement I

Step-by-step explanation:

1. Global warming causes the melting of glaciers and ice sheets, particularly in Greenland and Antarctica.
2. The meltwater flows into oceans and gets redistributed across the Earth's surface.
3. A considerable amount of this water moves from high latitudes towards lower latitudes, including the equatorial regions.
4. This changes the distribution of mass on Earth.
5. The redistribution changes Earth's moment of inertia and influences its rotation.
6. Consequently, Earth's rotational speed and the position of its rotational axis undergo measurable changes.

Simple analogy – An ice skater:

- When a spinning ice skater ***pulls their arms towards their body***, they **spin faster**.
- When they extend their arms outward, they spin slower.
- Similarly, when mass moves away from Earth's rotational axis towards lower latitudes, Earth's moment of inertia increases and its rotation slows slightly, assuming angular momentum is conserved.

Q4. Answer: (d)

Detailed Explanation :

Understanding the assertion

- The Indus and Ganga are two **distinct** river systems today.

- The Sutlej presently **drains westwards** into the Indus system.
- The Yamuna presently ***joins the Ganga*** system.
- However, geological changes during the Pleistocene **may have** reorganised their drainage connections.
- The assertion concerns the ***possibility of an earlier connection between these two drainage systems*** through changes in the courses of the Yamuna, Sutlej or their tributaries.

What is the Pleistocene?

- It is an epoch of the Quaternary Period.
- It extended from approximately 2.58 million years ago to 11,700 years ago.
- It was characterised by repeated glacial and interglacial phases.
- Tectonic activity, erosion, sediment deposition and climatic fluctuations influenced river systems.

Statement 1: The Nadi-Sukta of the Rigveda – Incorrect

Nadi-Sukta: Rigveda, Mandala 10, Hymn 75.

It is also known as the Nadistuti Sukta (Hymn in praise of rivers).

- It describes various rivers known to the Vedic people.
- It mentions important rivers such as Ganga, Yamuna, Sarasvati, Shutudri (Sutlej), Parushni (Ravi) and Sindhu (Indus).
- It provides valuable information about the geographical knowledge of the Vedic period.
- However, it does not provide geological or palaeohydrological evidence of river-course changes during the Pleistocene.
- The Pleistocene ended around 11,700 years ago, whereas the Rigvedic text belongs to a much later historical period.

Statement 2: Explorations of Sutlej and Yamuna by Robert Bruce Foote – Incorrect

Robert Bruce Foote (1834–1912)

British geologist and archaeologist, popularly known as the Father of Indian Prehistory.

- He worked with the Geological Survey of India.
- In 1863, he discovered a Palaeolithic stone handaxe at Pallavaram near Chennai, Tamil Nadu.
- His investigations contributed significantly to understanding India's prehistoric Stone Age cultures.
- His archaeological explorations covered several parts of India.
- However, the specific hypothesis of Pleistocene drainage changes involving the Sutlej and Yamuna is not based on his explorations of these rivers.

Statement 3: Presence of the same species of dolphins in both Indus and Ganga river systems – Correct

Indus River Dolphin

Scientific name: Platanista minor (in current species-level classification).

Ganges River Dolphin

Scientific name: Platanista gangetica.

This is the most important scientific basis of the assertion.

Why are river dolphins important evidence?

1. Both river systems contain closely related freshwater dolphins belonging to the genus Platanista.
2. These dolphins are adapted to freshwater river environments.
3. Their distribution in two geographically separated drainage basins raises an important biogeographical question: how did their ancestral populations spread between these river systems?
4. A possible explanation is that the Indus and Ganga drainage systems were interconnected in the geological past.
5. River-course changes, drainage capture and subsequent separation of river systems could have isolated their populations.
6. Such historical connections could have enabled faunal exchange between the two basins.

Theme-02

CLIMATOLOGY & MONSOON :

Q5. Answer: (d)

Detailed Explanation :

Statement 1: Presence of tall, closely set trees with crowns forming a continuous canopy

Correct

- Equatorial forests receive abundant rainfall and sunshine throughout the year.
- Favourable climatic conditions support continuous plant growth.
- Trees grow very tall, often exceeding 40–50 metres, with some emergent trees reaching greater heights.
- Trees are closely spaced, and their crowns overlap to form a dense, continuous canopy.

- Very little sunlight reaches the forest floor, resulting in limited undergrowth in many mature forests.

Vertical stratification of equatorial forests:

1. Emergent layer – Tallest trees projecting above the canopy.
2. Canopy layer – Dense crowns forming the main forest roof.
3. Understorey – Smaller trees, shrubs and shade-tolerant vegetation.
4. Forest floor – Limited sunlight, decomposing organic matter and rapid nutrient cycling.

Example: Amazon rainforest of South America.

Statement 2: Coexistence of a large number of species

Correct

- Equatorial forests are among the most biologically diverse terrestrial ecosystems on Earth.
- Constant warmth, abundant rainfall and year-round plant productivity create favourable conditions for numerous organisms.
- They support enormous diversity of trees, shrubs, climbers, insects, birds, mammals, amphibians and microorganisms.
- Many species are endemic, meaning they are naturally restricted to particular geographical regions.
- Unlike temperate forests, where a few tree species may dominate large areas, tropical rainforests often contain many different tree species within a small area.

Examples:

- Amazon: Jaguar, sloth, toucan and numerous tree species.
- Congo Basin: Gorillas, forest elephants and okapis.
- Southeast Asian rainforests: Orangutans, gibbons and tropical orchids.

Statement 3: Presence of numerous varieties of epiphytes

Correct

What are epiphytes?

Epiphytes are plants that grow on other plants, particularly tree trunks and branches, for physical support, without directly extracting nutrients from their host plants.

They are also called air plants.

Why are they abundant in equatorial forests?

- Dense canopy and intense competition for sunlight encourage some plants to grow on tree branches and trunks.
- High atmospheric humidity provides favourable moisture conditions.
- Organic debris accumulating on branches provides nutrients.
- The warm and humid environment supports diverse epiphytic vegetation.

Examples of epiphytes:

1. Orchids – Common tropical epiphytes.
2. Ferns – Grow on moist tree trunks and branches.
3. Bromeliads – Common in tropical American rainforests.
4. Mosses and lichens – Frequently occur on tree surfaces.

Q6. Answer: (a)

Statement 1: Thermal difference between land and water

Correct

This is the fundamental reason for the higher annual temperature range in continental interiors.

Why does land heat and cool faster than water?

Land has a lower specific heat capacity than water.

Water requires more energy to increase its temperature by the same amount.

Solar radiation heats land relatively quickly during summer.

During winter, land also loses heat relatively quickly.

Water heats and cools slowly, helping oceans moderate the temperature of nearby coastal regions.

Result:

Continental interiors → Hotter summers and colder winters.

Coastal areas → Cooler summers and warmer winters.

Example:

Verkhoyansk, Siberia: Experiences an extremely high annual temperature range.

Mumbai: Experiences a relatively moderate annual temperature range because of the Arabian Sea.

Statement 2: Variation in altitude between continents and oceans

Incorrect

Altitude refers to the height of a location above mean sea level.

Generally, temperature decreases with increasing altitude in the troposphere.

The normal environmental lapse rate is approximately 6.5°C per 1,000 metres.

However, altitude mainly influences the overall temperature of a location, not the general difference in annual temperature range between continental interiors and coastal areas.

The reason for this difference is the distance from the sea and the contrasting thermal properties of land and water.

Example: Shimla is cooler than Delhi mainly because of its higher altitude. This does not explain why continental interiors generally experience greater annual temperature ranges than coastal locations.

Statement 3: Presence of strong winds in the interior

Incorrect

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Winds are the horizontal movement of air from high-pressure regions towards low-pressure regions.

Winds transport heat and moisture from one geographical region to another.

Strong winds can sometimes moderate temperature extremes by mixing air masses and transporting heat.

However, the presence of strong winds in continental interiors is not a universal geographical characteristic

Strong winds are not the fundamental reason for the higher annual temperature range of continental interiors.

Statement 4: Heavy rains in the interior compared to coasts

Incorrect

Continental interiors generally receive less maritime moisture than coastal regions.

Coastal areas are often influenced by moisture-bearing winds from nearby oceans.

Heavy cloud cover and rainfall can moderate temperature fluctuations by reducing incoming solar radiation during the day and limiting heat loss at night.

However, rainfall distribution varies according to relief, wind direction, atmospheric circulation and distance from moisture sources.

There is no general rule that continental interiors receive heavier rainfall than coastal regions.

Example:

Mumbai receives substantial southwest monsoon rainfall due to moisture-bearing Arabian Sea winds and orographic uplift along the Western Ghats.

Interior regions of Rajasthan receive considerably less rainfall because of their distance from major moisture sources and regional atmospheric conditions.

Q7. Answer: (b)

Detailed Explanation :

(a) African Savannah – Incorrect

Location: Tropical Africa, particularly East Africa

Climate: Tropical wet-and-dry climate, with distinct rainy and dry seasons.

Rainfall: Moderate and seasonal, generally higher than in the semi-arid Central Asian Steppe.

Vegetation: Tall grasses interspersed with scattered trees such as acacia and baobab.

Human activities: Cattle rearing, subsistence agriculture and wildlife-based tourism.

Why incorrect?

Savannah regions are characterised by tropical temperatures rather than the marked continental temperature extremes of Central Asia.

Although pastoralism is practised in African savannahs, the combination of scanty rainfall, extreme seasonal temperatures and historical nomadic pastoralism is more characteristic of the Central Asian Steppe.

(b) Central Asian Steppe – Correct

Location: Central Eurasia, extending across Kazakhstan, Mongolia and adjoining regions.

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Climate: Temperate continental climate, with hot summers and severely cold winters.

Rainfall: Scanty, generally around 250–500 mm annually, varying considerably across the steppe belt.

Vegetation: Short grasses, herbs and scattered shrubs; trees are generally sparse.

Soil: Chernozem (black earth) occurs in relatively moist northern steppe areas, while chestnut and drier soils occur towards the south.

Why correct?

1. Its inland location creates a strong continental influence.'
2. Distance from oceans results in relatively low precipitation.
3. Extensive grasslands provide natural grazing grounds.
4. Historically, pastoral communities moved with their livestock according to the availability of pasture and water
5. Examples of traditional pastoral communities: Mongols – Mongolia.Kazakhs – Kazakhstan.Kyrgyz – Kyrgyzstan and adjoining Central Asian regions.

(c) North American Prairie – Incorrect

Location: Central North America, mainly the Great Plains of the USA and Canada.

Climate: Temperate continental climate, with hot summers and cold winters.

Rainfall: Moderate to relatively low, decreasing generally from east to west.

Vegetation: Tall-grass prairie in the east, mixed-grass prairie in the central region and short-grass prairie towards the west.

Soils: Highly fertile Mollisols, particularly suitable for agriculture.

Why incorrect?

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The Prairies are famous for extensive commercial agriculture, particularly wheat cultivation.

Mechanised farming and cattle ranching are major economic activities.

Historically, indigenous communities such as the Plains Indians depended heavily on hunting bison rather than practising the characteristic nomadic livestock pastoralism of Central Asian steppe communities.

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(d) Siberian Tundra – Incorrect

Location: Northern Siberia, Russia, extending towards the Arctic coast.

Climate: Polar climate, characterised by extremely long, severe winters and short, cool summers.

Rainfall: Very low precipitation, mostly in the form of snow.

Vegetation: Mosses, lichens, grasses and dwarf shrubs; trees are generally absent.

Soil: Permafrost, meaning permanently frozen ground beneath the seasonally thawed surface layer.

Why incorrect?

Although the tundra experiences extreme cold and scanty precipitation, its principal geographical characteristic is its polar environment and permafrost.

Traditional livelihoods include hunting, fishing and reindeer herding.

Indigenous communities such as the Nenets practise nomadic or semi-nomadic reindeer pastoralism.

However, the question's combination of extreme continental temperatures, scanty rainfall and historical nomadic livestock herding specifically identifies the Central Asian Steppe.

Q8. Answer: (d)

Detailed Explanation :

Statement 1: Meeting of cumulonimbus clouds in the sky

Incorrect

Cumulonimbus clouds are vertically developed, dense clouds associated with thunderstorms, heavy rainfall, lightning and sometimes hail.

Thunderstorms generally develop through the strong upward movement of warm, moist air, leading to the formation of cumulonimbus clouds.

However, the collision or meeting of two cumulonimbus clouds does not produce thunder.

Thunder is caused by the rapid expansion of air heated by lightning.

Statement 2: Lightning that separates the nimbus clouds

Incorrect

Lightning is an electrical discharge caused by the accumulation and separation of electrical charges within a thunderstorm or between a cloud and the ground.

It does not produce thunder by physically separating clouds.

Rather, lightning rapidly heats the surrounding air, producing the sound wave that we hear as thunder.

Thus, the statement identifies lightning but incorrectly describes its role.

Statement 3: Violent upward movement of air and water particles

Incorrect

Strong upward movement of warm, moist air is called an updraft.

Updrafts carry water droplets and ice particles upwards, helping in the development of cumulonimbus clouds.

Collisions among ice crystals, graupel and water droplets contribute to the separation of electrical charges, facilitating lightning formation.

However, these upward movements do not directly produce thunder. Thunder results from the explosive expansion of air surrounding the lightning channel.

Q9. Answer: (c)

Detailed Explanation :

(a) Equatorial climate

Incorrect

Found near the Equator, particularly in the Amazon Basin, Congo Basin and Indonesia.

Characterised by high temperatures and abundant rainfall throughout the year.

The Inter-Tropical Convergence Zone (ITCZ) and generally converging trade winds influence this climate.

There is no characteristic seasonal reversal of the prevailing winds comparable to the monsoon system.

Key feature: Uniformly hot and wet climate throughout the year.

(b) Mediterranean climate

Incorrect

Found mainly on the western margins of continents between approximately 30° and 40° latitudes, such as the Mediterranean region, central Chile, California and southwestern Australia.

Characterised by hot, dry summers and mild, wet winters.

In summer, subtropical high-pressure conditions dominate, while in winter the shifting westerly wind belt brings cyclonic disturbances and rainfall.

Although the prevailing weather systems change seasonally, this is not a characteristic reversal of wind direction like that of the monsoon climate.

Key feature: Dry summer and wet winter.

(c) Monsoon climate

Correct

Monsoon climate is characterised by the seasonal reversal of prevailing winds.

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This is strongly associated with the differential heating and cooling of land and sea, along with seasonal shifts in pressure belts and the ITCZ.

During summer, winds generally blow from sea to land, bringing moisture and rainfall.

During winter, winds generally reverse and blow from land towards the sea, producing relatively dry conditions over many regions.

Indian example:

South-West Monsoon (summer): Moisture-laden winds blow from the Indian Ocean towards the Indian landmass, bringing widespread rainfall.

North-East Monsoon (winter): Winds generally blow from the land towards the sea. However, after crossing the Bay of Bengal, they bring rainfall to Tamil Nadu and parts of the southeastern coast.

(d) All of the above climates

Incorrect

Equatorial climate is characterised by year-round heat and rainfall.

Mediterranean climate is characterised by dry summers and wet winters.

Monsoon climate is characterised by seasonal reversal of winds.

Since the defining feature in the question applies specifically to monsoon climate, this combined option is incorrect.

Q10. Answer: (b)

Detailed Explanation:

(a) Sea surface temperatures are low

Contributing factor, but not the keyed answer

Tropical cyclones generally require warm ocean water, approximately 26.5–27°C or higher, with sufficient heat stored below the surface.

The South Atlantic is influenced by the cold Benguela Current, while the south-eastern Pacific is influenced by the cold Humboldt (Peru) Current.

These currents cool the adjoining tropical ocean waters and make cyclone formation less favourable.

However, low sea-surface temperature is not the single distinguishing explanation expected by the question's answer key. The scarcity of suitable atmospheric disturbances and other unfavourable atmospheric conditions also matter.

(b) Inter-Tropical Convergence Zone seldom occurs

Correct

The ITCZ is a low-pressure belt near the Equator where the north-east and south-east trade winds converge.

This convergence causes warm, moist air to rise, producing cloud formation, thunderstorms and atmospheric instability.

The ITCZ can provide low-level convergence and pre-existing disturbances that may develop into tropical cyclones.

In the South Atlantic and south-eastern Pacific, the ITCZ generally remains close to or north of the Equator and rarely extends sufficiently southward over these regions.

Consequently, favourable conditions for tropical cyclone formation are less frequent.

(c) Coriolis force is too weak

Incorrect

The Coriolis force is the apparent deflecting force caused by Earth's rotation.

It helps a developing low-pressure system acquire and maintain rotation.

It is nearly zero at the Equator and increases with latitude.

Tropical cyclones rarely form within about 5° latitude of the Equator because the Coriolis force is insufficient there.

But the South Atlantic and south-eastern Pacific tropical regions extend beyond the immediate equatorial belt. Therefore, weak Coriolis force is not the specific reason for the scarcity of cyclones in these basins

(d) Absence of land in those regions

Incorrect

Tropical cyclones originate and intensify over warm ocean waters; they do not require land for their formation.

In fact, when a cyclone moves over land, it generally weakens because it loses its supply of warm, moist ocean air and experiences greater surface friction.

Therefore, the absence of land cannot explain the lack of cyclone formation.

Q11. Answer: (b)

Detailed Explanation :

Statement 1: The winds which blow between 30°N and 60°S latitudes throughout the year are known as westerlies.

Incorrect

Westerlies are permanent planetary winds that generally blow from the subtropical high-pressure belts towards the subpolar low-pressure belts.

They occur in the middle latitudes of both hemispheres, approximately:

Northern Hemisphere: 30°N–60°N.

Southern Hemisphere: 30°S–60°S.

The statement incorrectly gives the range as 30°N–60°S, which crosses the Equator and includes tropical wind belts.

Therefore, the latitude range is geographically incorrect.

Direction of westerlies:

Northern Hemisphere: generally south-west to north-east.

Southern Hemisphere: generally north-west to south-east.

Statement 2: The moist air masses that cause winter rains in North-Western region of India are part of westerlies.

Correct

During winter, north-western India receives rainfall mainly due to Western Disturbances.

Western Disturbances are eastward-moving extratropical weather systems originating around the Mediterranean–West Asian region.

They are embedded in the westerly circulation and are steered towards India by the westerly winds and associated upper-air systems.

They bring rainfall to Punjab, Haryana, Delhi, Rajasthan and western Uttar Pradesh, and snowfall over the western Himalayas.

This winter rainfall is particularly important for Rabi crops, especially wheat.

Western Disturbance: Causes, Features and Impact

Important technical distinction:

Westerlies: Large-scale planetary winds blowing from west to east in the mid-latitudes.

Western Disturbances: Individual extratropical weather systems travelling within the westerly circulation.

Subtropical Westerly Jet Stream: A high-altitude westerly air current that influences the movement of Western Disturbances towards India.

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Q12. Answer: (b)

Detailed Explanation :

(a) Savannah climate

Incorrect

Savannah is a tropical grassland climate, generally found between equatorial rainforests and tropical deserts.

It has distinct wet and dry seasons.

Rainfall is concentrated in the summer wet season, while the dry season may last several months.

It is characterised by tall grasses with scattered trees rather than dense evergreen rainforests.

Although convectional thunderstorms can occur during its wet season, the predictable daily rainfall pattern throughout the year described in the question is not its defining characteristic.

Examples: East African grasslands, parts of Brazil and northern Australia.

(b) Equatorial climate

Correct

Found close to the Equator, generally within approximately 5°–10° north and south, though the climatic extent varies geographically.

Receives strong solar radiation throughout the year.

High temperatures and humidity promote intense convection.

During the day, moist air gets heated and rises, cools at higher altitudes and condenses to form towering cumulonimbus clouds.

These clouds produce heavy rainfall accompanied by thunder and lightning, usually during the afternoon.

The rainfall is often short-lived, and the cycle repeats on most days.

Examples: Amazon Basin, Congo Basin and Indonesian region.

Important climatic characteristics:

Feature – Equatorial climate:

- **Temperature:** Uniformly high throughout the year
- **Annual temperature range:** Very low
- **Rainfall:** Heavy throughout the year
- **Rainfall type:** Mainly convectional
- **Seasons:** No distinct dry season in classic equatorial rainforest climate
- **Vegetation:** Tropical evergreen rainforest

(c) Monsoon climate

Incorrect

The defining feature of monsoon climate is the seasonal reversal of prevailing winds.It experiences distinct wet and dry seasons.

In India, the South-West Monsoon brings widespread rainfall mainly during June–September.

Rainfall may occur through orographic uplift, convection and cyclonic disturbances, but the passage describes a regular daily afternoon rainfall cycle rather than seasonal monsoon rainfall.

Examples: India, Bangladesh, Myanmar and parts of Southeast Asia.

(d) Mediterranean climate

Incorrect

Found mainly on the western margins of continents between approximately 30° and 40° latitudes.

Characterised by hot, dry summers and mild, wet winters.

Summer dryness is associated with subtropical high-pressure conditions.

Winter rainfall occurs when the westerly wind belt and associated temperate cyclones shift towards lower latitudes.

Therefore, the daily afternoon thunderstorm pattern described in the passage does not represent Mediterranean climate.

Examples: Mediterranean Basin, California, central Chile, Cape region of South Africa and south-western Australia.

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Q13. Answer: (b)

Detailed Explanation :

Statement 1: IOD is characterised by a difference in sea-surface temperature between the tropical Western Indian Ocean and tropical Eastern Pacific Ocean.

Incorrect

IOD stands for Indian Ocean Dipole.

It is an ocean–atmosphere phenomenon characterised by an east–west difference in sea-surface temperature (SST) anomalies across the tropical Indian Ocean.

Its two poles are:

Western pole: Western tropical Indian Ocean, near the eastern coast of Africa.

Eastern pole: Eastern tropical Indian Ocean, near Sumatra and Java (Indonesia).

The question incorrectly mentions the Eastern Pacific Ocean instead of the Eastern Indian Ocean.

UPSC conceptual distinction:

- **IOD** – Ocean basin: Indian Ocean; Main temperature contrast: Western vs Eastern Indian Ocean
- **ENSO** – Ocean basin: Pacific Ocean; Main temperature contrast: Central and Eastern vs Western equatorial Pacific

Statement 2: An IOD phenomenon can influence an El Niño's impact on the monsoon.

Correct

El Niño is the abnormal warming of the central and eastern equatorial Pacific Ocean.

It often weakens the Indian summer monsoon by influencing atmospheric circulation and reducing favourable monsoon conditions.

However, the IOD can modify this impact.

How does a positive IOD influence the El Niño effect?

During a positive IOD:

Western Indian Ocean becomes warmer than normal.

Eastern Indian Ocean, near Indonesia, becomes cooler than normal.

Convection and rainfall tend to increase over the western Indian Ocean.

This altered ocean–atmosphere circulation can favour Indian monsoon rainfall and partly compensate for El Niño's adverse influence.

Example: 1997

Despite a strong El Niño, India received near-normal monsoon rainfall. A strong positive IOD was an important contributing factor. .

Q14. Answer: (a)

Detailed Explanation :

(a) Does not set below the horizon at the Arctic Circle

Correct

On 21 June, the Northern Hemisphere is tilted towards the Sun.

The Arctic Circle lies at approximately 66½° N.

It marks the southern boundary of the region that experiences at least one day of 24-hour daylight during the year.

On the June Solstice, the Sun remains on or above the horizon at the Arctic Circle, including around midnight.

This phenomenon is called the Midnight Sun or Polar Day.

(b) Does not set below the horizon at Antarctic Circle

Incorrect

The Antarctic Circle lies at approximately 66½° S.

On 21 June, the Southern Hemisphere is tilted away from the Sun.

Consequently, the Antarctic Circle experiences approximately 24 hours of darkness.

The Sun does not rise above the horizon there. This is called Polar Night.

Remember: The Antarctic Circle experiences the Midnight Sun around 22 December, not 21 June.

(c) Shines vertically overhead at noon on the Equator

Incorrect

The Sun shines vertically overhead at the Equator around the two equinoxes:

March Equinox (around 20–21 March).

September Equinox (around 22–23 September).

On 21 June, the Sun is vertically overhead at the Tropic of Cancer, not the Equator.

UPSC point: The Equator receives overhead Sun twice a year, while locations between the Equator and the tropics can receive it twice a year, depending on their latitude.

(d) Shines vertically overhead at the Tropic of Capricorn

Incorrect

The Tropic of Capricorn lies at approximately 23½° S.

The Sun shines vertically overhead there around 21–22 December, during the December Solstice.

On 21 June, the vertical rays fall on the Tropic of Cancer (23½° N).

Key distinction: Tropic of Cancer = June Solstice; Tropic of Capricorn = December Solstice.

Q15. Answer: (b)

Detailed Explanation :

(a) Clouds absorb the radiation released from the Earth's surface.

Scientifically true, but not the best answer

The Earth's surface emits longwave (infrared) radiation, particularly during the night.

Clouds, especially those containing water droplets and ice crystals, absorb a significant portion of this outgoing terrestrial radiation.

They then emit longwave radiation both upwards and downwards.

The downward emission reduces the cooling of the Earth's surface.

Therefore, absorption is part of the physical process, but the key explanation for the absence of dew is the return of radiation towards the surface.

(b) Clouds reflect back the Earth's radiation.

Correct — UPSC keyed answer

Clouds act like a thermal blanket.

They intercept outgoing longwave radiation from the Earth's surface.

They send some of this energy back towards the ground through downward longwave radiation.

Consequently, the ground does not cool sufficiently to reach the dew point.

Without adequate cooling, water vapour near the ground is less likely to condense into dew.

(c) The Earth's surface would have low temperature on cloudy nights.

Incorrect

This statement is the opposite of the usual situation.

On a clear night, the Earth's surface loses heat rapidly through outgoing longwave radiation.

On a cloudy night, downward longwave radiation from clouds reduces the net heat loss.

Therefore, cloudy nights are generally warmer at the surface than comparable clear nights.

Remember: Clear sky → greater radiational cooling → greater possibility of dew.

(d) Clouds deflect the blowing wind to ground level.

Incorrect

Clouds do not prevent dew formation by deflecting winds towards the ground.

Wind does influence dew formation: strong winds mix the air near the surface and can inhibit the development of dew.

Calm or light-wind conditions are generally more favourable for dew formation.

However, this is not the mechanism described by the option.

Q16. Answer: (b)

Detailed Explanation :

Statement 1: OMT is measured up to a depth of 26°C isotherm, which is 129 metres in the south-western Indian Ocean during January–March.

Incorrect

OMT (Ocean Mean Temperature) represents the average temperature of the upper ocean layer, measured from the surface down to the depth where the water temperature reaches 26°C.

An isotherm is a line or surface joining points having the same temperature.

The 26°C isotherm is used as a reference because warm ocean water provides energy and moisture to the atmosphere, influencing weather and climate.

Its depth is not fixed; it varies with location, season and ocean conditions.

During January–March, its mean depth in the south-western Indian Ocean is approximatey 59 metres, not 129 metres.

Therefore, the specific numerical value given in the statement makes it incorrect.

Important UPSC distinction:

Parameter – Meaning:

- **SST (Sea Surface Temperature):** Temperature of the ocean surface
- **OMT (Ocean Mean Temperature):** Average temperature from the surface down to the 26°C isotherm
- **OHC (Ocean Heat Content):** Heat energy stored in a specified volume or depth of ocean water

Statement 2: OMT collected during January–March can be used in assessing whether monsoon rainfall will be less or more than a certain long-term mean.

Correct

The Indian summer monsoon is influenced by ocean–atmosphere interactions.

The tropical Indian Ocean stores heat and supplies moisture to the atmosphere through evaporation.

OMT captures the thermal condition of a deeper ocean layer, rather than only the temperature at the surface.

January–March OMT observations can therefore provide an early indication of the subsequent South-West Monsoon rainfall.

Researchers at the Indian Institute of Tropical Meteorology (IITM), Pune, have investigated OMT as a predictor of whether Indian monsoon rainfall will be above or below its long-term mean.

Why is OMT useful?

Sea Surface Temperature can change relatively quickly due to winds, evaporation and cloud cover. OMT incorporates temperatures below the immediate surface and therefore provides a more stable indication of upper-ocean thermal conditions.

Q17. Answer: (c)

Detailed Explanation :

Statement 1: Jet streams occur in the Northern Hemisphere only.

Incorrect

Jet streams are narrow bands of very high-speed winds occurring in the upper troposphere, generally around 9–16 km above the Earth's surface.They occur in both the Northern and Southern Hemispheres.

Major types include: Polar front jet stream: Found near the boundary between polar easterlies and mid-latitude westerlies, approximately 50°–60° latitude. Subtropical westerly jet stream: Generally found around 25°–35° latitude. Tropical easterly jet stream: A seasonal upper-air jet that develops over South Asia during the summer monsoon.

Statement 2: Only some cyclones develop an eye.

Correct

The eye is the relatively calm central region of a well-organised tropical cyclone.However, not every cyclone develops a clearly defined eye.Weak or developing tropical cyclones: Usually lack a well-defined eye.Mature and intense tropical cyclones: Often develop a distinct eye surrounded by an eyewall.Temperate cyclones: Generally do not have the characteristic eye of an intense tropical cyclone.

Important features of the eye: Relatively calm winds compared with the eyewall.Subsiding (descending) air.Often clearer skies and little rainfall.Lowest atmospheric pressure near the surface.Warmer air in the upper levels due to subsidence and compression.

Statement 3: The temperature inside the eye of a cyclone is nearly 10°C lesser than that of the surroundings.

Incorrect

The eye of a tropical cyclone is generally warmer than its surroundings, particularly in the upper troposphere. How does this happen?Air descends (subsides) inside the eye.As it descends, atmospheric pressure increases.The descending air gets compressed.Compression causes adiabatic warming.Consequently, the eye develops a warm core

Q18. Answer: (c)

Detailed Explanation :

1. Burrowing animals and termites-Not included

Termites and burrowing animals are important components of savannah ecosystems.Termites construct mounds, decompose organic matter and modify soil structure.Burrowing animals disturb and aerate the soil.However, these activities are not generally the major landscape-scale factors maintaining open savannah vegetation.

2. Fire-Correct

Savannahs experience frequent grassland fires, particularly during the dry season. Dry grasses provide abundant combustible material. Fires destroy young tree seedlings and suppress the regeneration of many woody plants. Many grasses can regenerate rapidly from underground growing points after fires.

3. Grazing herbivores-Correct

Savannahs support large populations of grazing and browsing herbivores.Grazers such as zebras and wildebeest consume grasses.Browsers such as giraffes and elephants feed on leaves, shoots and young trees.Heavy browsing, trampling and damage to saplings can restrict woody vegetation regeneration.

4. Seasonal rainfall-Correct

Savannahs generally experience distinct wet and dry seasons.During the wet season, grasses grow rapidly.During the prolonged dry season, water availability becomes a major limiting factor for vegetation.Continuous tree growth becomes difficult, particularly for young seedlings

5. Soil properties - Not included

Soil characteristics such as fertility, texture, depth and drainage certainly influence vegetation distribution.Some savannah soils have nutrient limitations, shallow profiles or poor water-retention capacity.However, soil properties are not taken as one of the three principal factors in this particular question's answer key.

Q19. Answer: (d)

Detailed Explanation :

Statement 1: High clouds primarily reflect solar radiation and cool the surface of the Earth.

Incorrect

High clouds, such as cirrus clouds, are generally thin and composed of ice crystals.They allow much of the incoming shortwave solar radiation to pass through.However, they

absorb some of the outgoing longwave (infrared) radiation emitted by the Earth's surface.They re-emit this energy in different directions, including back towards the Earth's surface.This reduces the rate at which heat escapes to space and produces a net warming effect.

Statement 2: Low clouds have a high absorption of infrared radiation emanating from the Earth's surface and thus cause warming effect.

Incorrect

Low clouds, such as stratus and stratocumulus, are generally thick and contain liquid water droplets.They reflect a substantial amount of incoming shortwave solar radiation back into space.Consequently, less solar energy reaches the Earth's surface.Although low clouds also absorb and emit infrared radiation, their relatively warm temperature means their additional greenhouse effect is comparatively small.Their dominant effect is generally cooling.

Q20. Answer: (c)

Detailed Explanation :

(a) The total amount of insolation received at the equator is roughly about 10 times that received at the poles.

Incorrect

Insolation means incoming solar radiation received by the Earth.The equatorial regions receive more direct solar radiation because the Sun's rays fall at a higher angle.At the poles, solar rays arrive at a very oblique angle and spread over a larger surface area.However, the difference is not approximately 10 times.

Region – Approximate insolation received at surface:

- **Tropics:** 320 W/m^2
- **Polar regions:** 70 W/m^2

The ratio is approximately 4.6:1, not 10:1.

(b) Infrared rays constitute roughly two-thirds of insolation.

Incorrect

Insolation consists of electromagnetic radiation of different wavelengths:Ultraviolet radiation (UV) ; Visible radiation ; Infrared radiation (IR)

Approximate distribution of incoming solar energy:

Radiation – Approximate share:

- **Ultraviolet:** 7%
- **Visible:** 43%
- **Infrared:** 50%

Therefore, infrared radiation contributes roughly half, not two-thirds, of incoming solar energy.

(c) Infrared waves are largely absorbed by water vapour that is concentrated in the lower atmosphere.

Correct

Water vapour is a greenhouse gas and is concentrated mainly in the lower atmosphere, particularly the troposphere.It absorbs significant portions of infrared radiation.It also emits infrared radiation in all directions, including towards the Earth's surface.This process contributes to the greenhouse effect and keeps the lower atmosphere warmer.

Incoming solar radiation: Water vapour absorbs some near-infrared radiation coming from the Sun.Outgoing terrestrial radiation: Water vapour absorbs significant portions of the longwave infrared radiation emitted by the Earth's surface.

(d) Infrared waves are a part of the visible spectrum of electromagnetic waves of solar radiation.

Incorrect

Infrared radiation is part of the electromagnetic spectrum, but it is not part of the visible spectrum.Visible light is the portion of electromagnetic radiation detectable by the human eye.Its approximate wavelength range is 0.4–0.7 micrometres.Infrared radiation has longer wavelengths than visible red light.Human eyes cannot normally detect infrared radiation, although we can experience its energy as heat.

Q21. Answer: (d)

Detailed Explanation :

Statement-I: The temperature contrast between continents and oceans is greater during summer than in winter.

Incorrect

The temperature contrast between continents and oceans is generally greater during winter, particularly in the Northern Hemisphere.During winter, large continental interiors lose heat rapidly.Land becomes extremely cold because it has a relatively low heat capacity.Oceans retain heat accumulated during warmer months and cool comparatively slowly.Consequently, continental interiors become much colder than neighbouring oceans.

Example:

Siberia experiences extremely low winter temperatures.The surrounding North Pacific and North Atlantic waters remain relatively warmer.This creates a substantial temperature difference between continental interiors and oceans.

Statement-II: The specific heat of water is more than that of land surface.

Correct

Specific heat capacity is the amount of heat required to raise the temperature of one unit mass of a substance by 1°C.Water has a much higher specific heat capacity than most land materials.

Substance – Approximate specific heat capacity:

- **Water:** 4,200 J/kg/°C
- **Dry soil:** 800 J/kg/°C
- **Sand:** 830 J/kg/°C

Consequences : Water takes more heat to increase its temperature.Water heats up slowly during summer.Water also loses heat slowly during winter.Land heats and cools relatively quickly.

Q22. Answer: (d)

Detailed Explanation :

Statement-I: The atmosphere is heated more by incoming solar radiation than by terrestrial radiation.

Incorrect

The atmosphere is relatively transparent to much of the incoming shortwave solar radiation. Therefore, a substantial part of this radiation reaches and heats the Earth's surface.The process takes place in the following sequence: Incoming solar radiation.Shortwave radiation from the Sun.Earth's surface absorbs energy.Land and oceans become warm.Terrestrial radiation Earth emits longwave infrared radiation.Atmosphere absorbs radiation Greenhouse gases absorb and re-emit infrared energy.Thus, the atmosphere is heated primarily by terrestrial radiation and associated processes such as conduction and convection from the Earth's surface.

Statement-II: Carbon dioxide and other greenhouse gases in the atmosphere are good absorbers of longwave radiation.

Correct

The Earth's surface emits energy mainly in the form of longwave infrared radiation.Greenhouse gases such as carbon dioxide (CO_2), water vapour (H_2O), methane (CH_4) and nitrous oxide (N_2O) absorb specific wavelengths of this radiation.These gases subsequently emit infrared radiation in different directions, including towards the Earth's surface.This process contributes to the natural greenhouse effect and keeps the Earth's surface and lower atmosphere warmer.

Q23. Answer: (a)

Detailed Explanation :

Statement-I: Thickness of the troposphere at the equator is much greater as compared to poles.

Correct

The troposphere is the lowest layer of the atmosphere, extending from the Earth's surface up to the tropopause.

Its thickness varies with latitude:

Region – Approximate height of tropopause:

- **Equator:** 16–18 km
- **Mid-latitudes:** 10–12 km
- **Poles:** 8–10 km

Reasons:Equatorial regions receive intense solar heating.Air becomes warmer, expands and rises.This produces a greater vertical extent of the troposphere.Polar regions are much colder, with less vertical expansion of air..

Statement-II: At the equator, heat is transported to great heights by strong convectional currents.

Correct

The equatorial region receives intense solar radiation throughout the year.The Earth's surface gets heated and warms the air above it.Warm air becomes less dense and rises.Cooler surrounding air moves in to replace the rising air.This creates strong vertical convectional currents.These currents transport heat, moisture and air to higher altitudes.

Q24. Answer: (a)

Detailed Explanation :

Statement 1: The isotherms deviate to the north over the ocean and to the south over the continent.

Correct

Isotherms are imaginary lines joining places having equal temperatures.In January, it is winter in the Northern Hemisphere.Land loses heat rapidly because it has a lower specific heat capacity.Oceans lose heat slowly because water has a higher specific heat capacity.Therefore, oceans remain relatively warmer than continents at the same latitude.As a result, isotherms bend northward over oceans and southward over continents.

Example: North Atlantic region

During January, the North Atlantic Ocean remains relatively warmer than the neighbouring continental interiors. Hence, isotherms extend towards higher latitudes over the ocean, while they bend towards lower latitudes over Europe and Asia.

Statement 2: The presence of cold ocean currents, Gulf Stream and North Atlantic Drift make the North Atlantic Ocean colder and the isotherms bend towards the north.

Incorrect

The statement contains a major factual error: the Gulf Stream and North Atlantic Drift are warm ocean currents, not cold currents.

Gulf Stream : Warm ocean current.Flows from the Gulf of Mexico along the eastern coast of North America.Carries warm tropical water towards the North Atlantic.

North Atlantic Drift : Warm extension of the Gulf Stream system.Transports relatively warm water towards north-western Europe.Moderates the climate of parts of western Europe.

How do these currents affect isotherms? : Warm currents raise the temperature of adjoining oceanic regions.The North Atlantic becomes warmer than other regions at comparable latitudes.Isotherms consequently bend towards higher latitudes (northward).

Q25. Answer: (a)

Detailed Explanation :

Statement 1: It is a gas, the amount of which decreases with altitude.

Correct

Water vapour is the gaseous form of water present in the atmosphere.It is a variable gas because its concentration changes with location, altitude and weather conditions.Most atmospheric water vapour is concentrated in the lower atmosphere, particularly the troposphere.As altitude increases, temperature generally decreases, reducing the capacity of air to contain water vapour.Rising moist air cools, and water vapour condenses to form clouds and precipitation.

In warm and wet tropical regions, water vapour may constitute approximately 4% of atmospheric air by volume.In cold and dry polar and desert regions, it may constitute less than 1%. Important point: Nearly 90% of atmospheric moisture is concentrated within approximately the lowest 5–6 km of the atmosphere.

Statement 2: Its percentage is maximum at the poles.

Incorrect

Water vapour concentration is generally highest in warm, humid tropical regions and lowest in cold, dry polar regions.

Reasons: Equatorial regions receive intense solar radiation.Higher temperatures promote evaporation from oceans, rivers and other water bodies.Warm air can contain considerably more water vapour before reaching saturation.Polar regions have extremely low temperatures, resulting in very low atmospheric moisture content.

Remember the geographical distribution: Equator → High water vapour content. Tropics → Generally high water vapour content. Subtropics → Relatively low in many dry regions. Poles → Very low water vapour content.

Q26. Answer: (d)

Detailed Explanation :

Correct answer: (d) Marine West Coast climate

This is a UPSC Civil Services Preliminary Examination 2024 question.

The three characteristics point towards the Marine West Coast climate (Köppen Cfb), a temperate maritime climate found mainly along the western margins of continents in the middle latitudes.

1. Explanation of each option

(a) Equatorial climate

Incorrect

Found approximately between 5°–10° north and south of the Equator.Temperature remains uniformly high throughout the year.Both annual and daily temperature ranges are generally low.Rainfall occurs throughout the year due to strong convection.Annual rainfall is generally very high, often exceeding 200–250 cm.Examples: Amazon Basin, Congo Basin and Indonesia.

(b) China type climate-Incorrect

China type climate is a warm temperate eastern margin climate, also called the humid subtropical monsoon climate.Summers are hot and humid.Winters are comparatively cool and dry.Rainfall occurs mainly during summer, although some precipitation can occur throughout the year.Annual temperature range is generally greater than in the Marine West Coast climate.

Examples: Eastern China, southern Japan and parts of south-eastern USA.

(c) Humid subtropical climate- **Incorrect**

Found mainly between 25°–40° latitude, particularly on the eastern sides of continents.Summers are hot and humid.Winters are generally mild to cool.Rainfall may occur throughout the year, with a summer maximum in many regions.Annual temperature range is comparatively greater than in maritime climates. Examples: South-eastern USA, eastern China and parts of eastern Australia.

(d) Marine West Coast climate

Correct

1. Low annual and daily temperature range : Proximity to oceans moderates temperatures.Oceans heat and cool slowly due to their high specific heat capacity.Summers are mild and winters are relatively moderate.

2. Precipitation throughout the year : Prevailing westerlies transport moisture from oceans towards western continental margins.Temperate cyclones and associated fronts produce rainfall throughout the year.There is generally no pronounced dry season.

3. Annual precipitation of approximately 50–250 cm.Rainfall varies according to location, exposure to moist winds and relief.Windward mountain slopes may receive considerably higher rainfall. Examples: North-western Europe (United Kingdom, western France).Pacific north-western USA and Canada.Southern Chile.New Zealand.South-eastern Australia.

Q27. Answer: (c)

Detailed Explanation :

Statement 1: It increases with increase in wind velocity.

Correct

Coriolis force is directly proportional to the velocity of the moving object.Therefore, as wind velocity increases, the magnitude of Coriolis force also increases, provided latitude remains constant.

Mathematically:

[F=2m v\Omega\sin\phi \]

Where: (F\) = Coriolis force ; (m\) = Mass of moving air ;(v\) = Velocity of wind ; (\Omega\) = Angular velocity of Earth ; (\phi\) = Latitude

Statement 2: It is maximum at the poles and is absent at the equator- Correct

Coriolis force depends on the sine of latitude (\(\sin\phi\)).At the Equator (0° latitude), \(\sin 0°=0\). Hence, the horizontal Coriolis force is zero.At the poles (90° latitude), \(\sin 90°=1\). Hence, the horizontal Coriolis force is maximum.

- **Equator** – Latitude: 0°; Coriolis force: Zero
- **30° N/S** – Latitude: 30°; Coriolis force: 50% of maximum
- **60° N/S** – Latitude: 60°; Coriolis force: About 86.6% of maximum
- **Poles** – Latitude: 90°; Coriolis force: Maximum

Q28. Answer: (d)

Detailed Explanation :

Statement 1: Equator-Incorrect

The Equator receives approximately 12 hours of daylight and 12 hours of darkness throughout the year.This happens because the Equator is almost equally divided by the circle of illumination throughout the year.Therefore, on June 21, the Equator does not experience more than 12 hours of sunlight.

Statement 2: Tropic of Cancer-Correct

On June 21, the Sun's vertical rays fall directly on the Tropic of Cancer (23½° N).The Northern Hemisphere is tilted towards the Sun.Consequently, the Tropic of Cancer experiences more than 12 hours of daylight.It has its longest day of the year around this date.

Statement 3: Tropic of Capricorn-Incorrect

The Tropic of Capricorn is located at 23½° S.On June 21, the Southern Hemisphere is tilted away from the Sun.Therefore, it experiences less than 12 hours of daylight.It experiences its shortest day of the year around this date.

Statement 4: Arctic Circle-Correct

The Arctic Circle is located approximately at 66½° N.On June 21, the Northern Hemisphere is tilted towards the Sun.The Arctic Circle experiences approximately 24 hours of continuous daylight.This phenomenon is known as the Midnight Sun (Polar Day).

Q29. Answer: (c)

Detailed Explanation :

Statement I: The amount of dust particles in the atmosphere is more in subtropical and temperate areas than in equatorial and polar regions.-Correct

Subtropical and temperate regions contain extensive deserts, semi-arid lands and dry continental interiors.Strong winds lift loose soil and mineral particles from these dry surfaces into the atmosphere.Equatorial regions receive heavy rainfall and have dense vegetation. Rainfall removes suspended dust through a process called wet deposition (rainout and washout).Polar regions are largely covered by ice and snow, limiting the availability of loose surface dust.

Examples:

- **Subtropical** – Examples: Sahara, Arabian Desert, Thar; Dust conditions: High dust availability
- **Temperate** – Examples: Central Asian drylands, parts of continental interiors; Dust conditions: Significant dust availability
- **Equatorial** – Examples: Amazon Basin, Congo Basin; Dust conditions: Frequent rainfall removes airborne particles
- **Polar** – Examples: Antarctica, Greenland; Dust conditions: Limited local dust sources

Statement II: Subtropical and temperate areas have less dry winds-Incorrect

This statement is the opposite of the actual geographical conditions.

Subtropical regions, particularly around 20°–30° latitudes, experience descending air associated with subtropical high-pressure belts.Descending air becomes warmer and relatively drier, inhibiting cloud formation and rainfall.These dry conditions favour desert formation and the availability of loose dust particles.Temperate continental interiors also experience dry and dusty winds, particularly in semi-arid regions.

Examples: Sahara Desert – Dry winds lift and transport enormous quantities of mineral dust.Arabian Desert – Strong winds transport dust over large distances.Central Asia – Dust storms occur in arid and semi-arid continental interiors.

Q30. Answer: (a)

Detailed Explanation :

Statement I: In January, in the Northern Hemisphere, the isotherms bend equatorward while crossing the landmasses, and poleward while crossing the oceans-Correct

January is winter in the Northern Hemisphere.Land loses heat rapidly because it has a relatively lower specific heat capacity.Consequently, continental interiors become much colder than neighbouring oceans.Over colder landmasses, isotherms bend towards the Equator (southward).Over relatively warmer oceans, isotherms bend towards the poles (northward).

Why does this happen? : Imagine an isotherm representing 10°C:Over a cold continent, it must move southwards to find locations having 10°C.Over a relatively warm ocean, it must move northwards to find locations having 10°C.

Statement II: In January, the air over the oceans is warmer than that over the landmasses in the Northern Hemisphere-Correct

Land has a relatively low specific heat capacity and heats up and cools down quickly.Water has a high specific heat capacity and heats up and cools down slowly.During summer, oceans absorb and store substantial amounts of heat.During winter, oceans release this stored heat gradually, whereas landmasses cool rapidly.Consequently, in January, the air over oceans is generally warmer than the air over neighbouring landmasses at comparable latitudes.

Examples: Western Europe is relatively warmer in winter due partly to the North Atlantic Drift.Interior Siberia experiences extremely low winter temperatures because of continentality.The North Atlantic and North Pacific moderate the temperatures of surrounding coastal regions.

How does Statement II explain Statement I?

Cause-and-effect : Land cools rapidly in winter.Lower heat capacity.Continents become colder.Isotherms bend equatorward over land.Oceans cool slowly in winter.Higher heat capacity.Oceans remain relatively warmer.Isotherms bend poleward over oceans