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PART-A

1. “Sustainable development is an ideal-a goal towards which all human societies need to be moving” Justify the statement with suitable arguments. 8

Sustainable development stands as an imperative for humanity, embodying not only an ideal but a practical necessity for the continued well-being of our planet and its inhabitants. This assertion is fortified by a plethora of arguments that underscore the critical importance of sustainable development as a guiding principle for all societies worldwide.

Environmental Preservation: At the core of sustainable development lies the imperative to preserve our environment for present and future generations. The earth's resources are finite, and unchecked exploitation jeopardizes not only the integrity of ecosystems but also the viability of essential services they provide, such as clean air, water, and fertile soil. By pursuing sustainable development, societies commit to stewarding these resources responsibly, ensuring their availability for posterity.

Economic Stability and Equity: Sustainable development promotes economic stability by encouraging practices that balance economic growth with social equity and environmental conservation. By investing in renewable energy, sustainable agriculture, and green infrastructure, societies mitigate the risks associated with resource depletion, environmental degradation, and climate change. Moreover, sustainable practices foster inclusive growth, reducing disparities in wealth and opportunity and promoting social cohesion.

Climate Change Mitigation: The urgency of addressing climate change underscores the necessity of sustainable development. Greenhouse gas emissions resulting from human activities pose an existential threat to ecosystems, economies, and human well-being. Sustainable development offers a roadmap for transitioning to low-carbon economies, embracing renewable energy sources, and adopting resilient infrastructure to mitigate the impacts of climate change and build a more sustainable future.

Interconnected Global Challenges: Sustainable development acknowledges the interconnected nature of global challenges, recognizing that issues such as poverty, hunger, health disparities, and environmental degradation are intertwined. Addressing these challenges requires holistic solutions that consider their interdependencies. By adopting a sustainable development framework, societies can pursue integrated approaches that simultaneously

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address social, economic, and environmental dimensions of development, fostering synergies and maximizing impact.

Ethical Imperative: Beyond its practical benefits, sustainable development embodies an ethical imperative rooted in principles of justice, equity, and intergenerational responsibility. Every individual, regardless of nationality or socioeconomic status, has a fundamental right to a healthy environment and a dignified standard of living. By prioritizing sustainability, societies uphold these rights, ensuring that current prosperity does not come at the expense of future generations' well-being.

Innovation and Resilience: Sustainable development stimulates innovation by incentivizing the development and adoption of environmentally friendly technologies and practices. From renewable energy solutions to circular economy models, sustainable approaches drive technological advancement while reducing environmental impacts. Moreover, by building resilience to environmental shocks and disruptions, sustainable development equips societies to navigate uncertain futures and thrive in the face of adversity.

Cultural Preservation: Sustainable development values cultural diversity and heritage, recognizing the intrinsic value of indigenous knowledge and traditional practices in fostering sustainable relationships with the environment. By integrating traditional wisdom with modern scientific approaches, societies can leverage diverse perspectives to inform sustainable development strategies that are both effective and culturally appropriate.

International Cooperation: Sustainable development necessitates global cooperation and solidarity to address transboundary challenges such as climate change, biodiversity loss, and resource depletion. Through multilateral agreements, partnerships, and shared goals, nations can collectively advance the sustainable development agenda, pooling resources, expertise, and innovation to tackle shared challenges that no single country can solve alone.

sustainable development represents an indispensable ideal and a practical imperative for all human societies. By embracing sustainability as a guiding principle, societies can safeguard the planet, promote prosperity, and ensure a dignified quality of life for present and future generations. The pursuit of sustainable development is not merely an option but a moral imperative, demanding collective action and unwavering commitment from all members of the global community.

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2. Marine ecosystem is the largest and most stable ecosystem on the earth and is of great ecological significance. Elucidate your answer with suitable examples. 8

Marine ecosystems encompass the vast and diverse realms of our planet's oceans and seas, comprising an intricate web of life that sustains ecological balance and provides invaluable services to both marine life and humanity. These ecosystems are not only the largest but also among the most stable on Earth, playing a pivotal role in regulating climate, supporting biodiversity, and sustaining livelihoods worldwide. To appreciate their ecological significance, one must delve into the myriad functions and examples that underscore the vital importance of marine ecosystems.

Biodiversity Hotspots: Marine ecosystems harbor unparalleled biodiversity, boasting a plethora of species ranging from microscopic plankton to colossal whales. Coral reefs, for instance, are renowned as biodiversity hotspots, supporting a staggering array of marine life, including fish, invertebrates, and algae. These vibrant ecosystems teem with life and contribute to global biodiversity by providing habitat, shelter, and feeding grounds for countless species.

Climate Regulation: Marine ecosystems play a crucial role in regulating Earth's climate by absorbing and sequestering carbon dioxide (CO₂) from the atmosphere. Phytoplankton, microscopic algae found in oceans, are prolific carbon fixers, photosynthesizing CO₂ and converting it into organic matter. Additionally, ocean currents and circulation patterns help distribute heat around the globe, influencing regional climates and weather systems. By mitigating climate change impacts, marine ecosystems contribute to the stability of the Earth's climate system.

Nutrient Cycling: Marine ecosystems facilitate nutrient cycling on a global scale, recycling essential elements such as nitrogen, phosphorus, and carbon through biogeochemical processes. For instance, marine bacteria and phytoplankton play a vital role in the ocean's biological pump, transferring nutrients from surface waters to the deep sea through a process known as marine snow. This cycling of nutrients sustains marine productivity and supports the entire food web, from primary producers to apex predators.

Economic Importance: Marine ecosystems provide invaluable ecosystem services that underpin economic activities and livelihoods worldwide. Fisheries, for example, rely on healthy marine ecosystems to support commercial fish stocks and sustain fishing industries. Coastal communities depend on mangrove forests and seagrass meadows for coastal protection,

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storm surge mitigation, and nursery grounds for fish and shellfish. Additionally, marine tourism, including activities such as diving, snorkeling, and wildlife watching, generates significant revenue and supports local economies in coastal regions.

Carbon Sequestration: Marine ecosystems, particularly coastal habitats such as mangrove forests, salt marshes, and seagrass meadows, serve as vital carbon sinks, sequestering carbon from the atmosphere and storing it in biomass and sediments. Mangroves, for instance, are highly efficient at trapping carbon dioxide through photosynthesis and storing it in their extensive root systems and sediments. By sequestering carbon, marine ecosystems help mitigate climate change and reduce atmospheric CO₂ concentrations.

Cultural and Recreational Value: Marine ecosystems hold profound cultural and recreational value for communities worldwide, serving as sources of inspiration, wonder, and spiritual connection. Coastal cultures often have deep-rooted traditions and practices associated with the sea, including fishing, sailing, and storytelling. Moreover, marine ecosystems provide opportunities for recreation and leisure activities, from beachcombing and birdwatching to surfing and boating, enhancing quality of life and well-being for millions of people.

Resilience and Adaptation: Marine ecosystems exhibit remarkable resilience in the face of environmental disturbances and climate variability. Coral reefs, for example, have evolved mechanisms to withstand temperature fluctuations, storms, and predation. Additionally, marine species demonstrate adaptive capacities, migrating to new habitats or adjusting their behaviors in response to changing environmental conditions. This resilience is essential for maintaining ecosystem functions and services in the face of ongoing environmental change.

Global Connectivity: Marine ecosystems are interconnected across vast oceanic expanses, forming a complex network of habitats and migration routes for marine species. Ocean currents, such as the Gulf Stream and the Antarctic Circumpolar Current, facilitate the movement of nutrients, larvae, and organisms between different regions of the world's oceans. This global connectivity promotes genetic exchange, biodiversity, and resilience, ensuring the long-term survival of marine species in a dynamic and ever-changing environment.

marine ecosystems represent the largest and most stable ecosystems on Earth, with profound ecological significance that extends far beyond their watery realms. From regulating climate and supporting biodiversity to sustaining livelihoods and cultural heritage, marine ecosystems provide a multitude of benefits that are essential for the health and well-being of our planet and its inhabitants. Protecting and preserving these invaluable ecosystems is not only a moral

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imperative but also a practical necessity for ensuring a sustainable future for generations to come.

3. "Poverty amidst plenty, nature is bountiful but tribals are poor" explain this statement with respect to forest resources. 7

Poverty Amidst Plenty: Tribals and Forest Resources

The phrase "poverty amidst plenty, nature is bountiful but tribals are poor" encapsulates a poignant reality that persists in many regions worldwide, particularly in areas where indigenous and tribal communities rely heavily on forest resources for their livelihoods. Despite the abundance of natural resources found in forested landscapes, these communities often face economic deprivation, social marginalization, and environmental degradation. To fully understand this statement, it is essential to delve into the intricate relationship between tribal communities and forest resources, exploring the factors that contribute to their poverty despite the richness of their natural surroundings.

Dependence on Forest Resources: Indigenous and tribal communities have historically depended on forests for their sustenance, livelihoods, and cultural identity. Forest resources such as timber, non-timber forest products (NTFPs), medicinal plants, and wildlife form the cornerstone of their economies, providing food, shelter, medicine, and income generation opportunities. These communities possess traditional knowledge and practices that enable sustainable resource management and utilization, ensuring the longevity of forest ecosystems while meeting their material needs.

Exploitative Practices: Despite their vital role in conserving and managing forest resources, indigenous and tribal communities often face exploitation and marginalization at the hands of external actors, including governments, corporations, and non-governmental organizations (NGOs). Historical injustices, land dispossession, and discriminatory policies have deprived these communities of their ancestral lands and undermined their traditional governance systems. Furthermore, commercial logging, mining, agricultural expansion, and infrastructure development have encroached upon indigenous territories, leading to deforestation, habitat destruction, and loss of biodiversity.

Lack of Access to Markets and Services: Tribal communities frequently encounter barriers to accessing markets, financial services, and basic amenities, perpetuating their poverty and economic vulnerability. Limited infrastructure, poor transportation networks, and geographical

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isolation hinder their ability to engage in commercial activities and trade their forest products at fair prices. Additionally, inadequate healthcare, education, and social services exacerbate socio-economic disparities and impede their socio-economic development. As a result, many tribal communities remain trapped in a cycle of poverty, unable to break free from the constraints imposed by their socio-economic circumstances.

Loss of Traditional Knowledge and Practices: The erosion of traditional knowledge and cultural practices poses a significant threat to the resilience and sustainability of indigenous and tribal communities. Rapid socio-economic changes, cultural assimilation, and acculturation disrupt traditional ways of life, leading to the loss of indigenous languages, customs, and ecological wisdom. This loss undermines the adaptive capacity of these communities to cope with environmental changes and exacerbates their vulnerability to external pressures. Preserving and revitalizing traditional knowledge systems is therefore essential for safeguarding the cultural heritage and ecological integrity of indigenous and tribal peoples.

Land Rights and Resource Governance: Securing land rights and strengthening resource governance are fundamental to addressing poverty among indigenous and tribal communities. Recognizing and respecting their customary land tenure systems, traditional territories, and collective rights to land and resources are critical steps towards empowering these communities and promoting sustainable development. Moreover, fostering inclusive and participatory approaches to natural resource management, such as community-based conservation initiatives and co-management arrangements, enhances local ownership, accountability, and stewardship of forest resources.

Empowerment and Capacity Building: Empowering indigenous and tribal communities through capacity building, education, and skills training is essential for unlocking their potential and enabling them to pursue alternative livelihood opportunities. Investing in education, vocational training, entrepreneurship, and sustainable agriculture equips these communities with the tools and knowledge needed to diversify their income sources, reduce dependency on forest resources, and enhance their resilience to socio-economic shocks. Moreover, fostering partnerships and collaborations between indigenous organizations, civil society groups, governments, and the private sector can facilitate the co-creation of innovative solutions and inclusive development strategies tailored to the specific needs and aspirations of tribal communities.

Recognition of Indigenous Rights and Traditional Knowledge: Respecting and upholding the rights of indigenous peoples, including their right to self-determination, cultural integrity,

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and traditional knowledge, is essential for promoting social justice, equity, and human rights. Implementing international frameworks such as the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) and the Convention on Biological Diversity (CBD) can help ensure that indigenous voices are heard, their rights are protected, and their contributions to biodiversity conservation and sustainable development are recognized and valued.

the juxtaposition of poverty amidst plenty underscores the complex interplay between natural resources, socio-economic inequalities, and indigenous rights. While forests abound with wealth and abundance, indigenous and tribal communities often find themselves marginalized and impoverished, deprived of their rights, resources, and opportunities. Addressing the root causes of poverty among these communities requires a multi-dimensional approach that encompasses land rights, resource governance, cultural empowerment, and social justice. Only through concerted efforts to uphold indigenous rights, preserve traditional knowledge, and promote inclusive development can we strive towards a future where nature's bounty is equitably shared, and tribal communities can thrive in harmony with their forested homelands.

4. "India's energy needs can only lie in adopting non-conventional sources of energy". Explain in detail. 7

India, as one of the world's most populous countries and fastest-growing economies, faces formidable challenges in meeting its burgeoning energy demand while addressing environmental concerns and ensuring energy security. The transition towards non-conventional or renewable sources of energy emerges as not only a viable option but a necessary imperative to address these multifaceted challenges comprehensively. This shift is underpinned by several compelling factors that underscore the critical role of non-conventional energy sources in fulfilling India's energy needs.

Energy Security and Independence: India's heavy reliance on imported fossil fuels, such as oil and natural gas, poses significant risks to its energy security, given the volatility of global energy markets and geopolitical tensions. By diversifying its energy mix with non-conventional sources such as solar, wind, and biomass, India can reduce its dependence on imported fuels and enhance its energy self-sufficiency. Moreover, renewable energy resources are abundant domestically, offering a sustainable and indigenous solution to meeting India's energy needs.

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Environmental Sustainability: India faces pressing environmental challenges, including air pollution, water scarcity, and climate change, exacerbated by the burning of fossil fuels for energy generation. Transitioning to non-conventional energy sources can mitigate these environmental impacts by reducing greenhouse gas emissions, improving air quality, and conserving water resources. Solar and wind power, in particular, offer clean and renewable alternatives to coal and gas-fired power plants, aligning with India's commitments to combat climate change under the Paris Agreement.

Cost Competitiveness and Economic Growth: The declining costs of renewable energy technologies, coupled with advancements in energy storage and grid integration, have made non-conventional sources increasingly cost-competitive with conventional fossil fuels. Solar and wind power, in particular, have witnessed dramatic cost reductions in recent years, making them attractive options for meeting India's energy needs while stimulating economic growth and job creation. By investing in renewable energy infrastructure and manufacturing, India can capitalize on the economic opportunities presented by the transition to clean energy.

Energy Access and Rural Development: Access to modern and reliable energy services remains a challenge for millions of people in rural and remote areas of India. Non-conventional energy sources, such as decentralized solar power systems and biomass-based mini-grids, offer scalable and cost-effective solutions to extend energy access to underserved communities. These off-grid and distributed energy solutions not only improve livelihoods, education, and healthcare but also contribute to rural development and poverty alleviation.

Technological Innovation and Leadership: India has emerged as a global leader in renewable energy deployment, with ambitious targets for solar and wind power capacity expansion. Leveraging its vast renewable energy potential and investing in research and development (R&D) can foster technological innovation and drive down costs further. Additionally, promoting indigenous manufacturing of renewable energy equipment and components can enhance India's competitiveness in the global clean energy market while supporting the government's "Make in India" initiative.

Grid Resilience and Energy Transition: Integrating variable renewable energy sources, such as solar and wind power, into the electricity grid requires innovative solutions to ensure grid stability and resilience. Smart grid technologies, energy storage systems, demand-side management, and grid-scale renewables can enhance grid flexibility and accommodate higher shares of intermittent renewable generation. By modernizing its grid infrastructure and embracing digital technologies, India can facilitate a smooth and efficient transition to a renewable energy future.

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Social Equity and Inclusive Development: The transition to non-conventional energy sources presents an opportunity to foster social equity and inclusive development by prioritizing the needs of marginalized communities and vulnerable populations. Initiatives such as decentralized renewable energy projects, community-owned solar installations, and skill development programs can empower local communities and enhance their participation in the clean energy transition. By ensuring that the benefits of renewable energy reach all segments of society, India can build a more equitable and sustainable energy future.

India's energy needs can only be effectively met through a concerted effort to embrace non-conventional sources of energy. By prioritizing renewable energy deployment, India can enhance its energy security, mitigate environmental impacts, stimulate economic growth, expand energy access, foster technological innovation, strengthen grid resilience, and promote social equity. Embracing the clean energy transition is not only imperative for India's sustainable development but also offers a pathway towards a brighter, cleaner, and more prosperous future for all its citizens.

5. Answer the following questions in about 150 words each. 4x5

a) Explain the significance of Kul and Bamboo drip irrigation practices.

Kul and bamboo drip irrigation practices hold significant importance, particularly in arid and semi-arid regions, for their effectiveness in conserving water and sustaining agricultural productivity.

Kul Irrigation: Kul irrigation is a traditional water management system prevalent in the mountainous regions of the Indian subcontinent. It involves diverting water from natural springs or streams into small earthen channels or canals (kuls) that run along the contours of the terrain. These kuls distribute water to fields through gravity, allowing for efficient irrigation of crops such as rice, wheat, and vegetables. Kul irrigation not only optimizes water use by minimizing losses due to evaporation and runoff but also helps recharge groundwater and maintain soil moisture levels, thereby enhancing agricultural resilience in water-stressed environments.

Bamboo Drip Irrigation: Bamboo drip irrigation is a simple yet effective technique used in hilly and forested areas to deliver water directly to the roots of plants. It involves puncturing bamboo stems to create small holes through which water drips slowly onto the soil. This method ensures targeted irrigation, minimizing water wastage and maximizing water-use

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efficiency. Bamboo drip irrigation is particularly suited for irrigating crops such as coffee, tea, and vegetables, where precise water application is critical for optimal growth and yield. Additionally, bamboo drip systems are low-cost, easy to install, and environmentally friendly, making them accessible to smallholder farmers with limited resources.

kul and bamboo drip irrigation practices offer sustainable solutions for agricultural water management, helping farmers cope with water scarcity, mitigate the impacts of climate change, and enhance food security in marginal and water-stressed regions.

b) “Soil which forms the uppermost layer of the land, is the most precious of all resources”. Explain this statement.

Soil, as the uppermost layer of the land, is indeed one of the most precious resources on Earth due to its indispensable role in supporting life and sustaining ecosystems. This thin layer of soil, formed through the complex interactions of geological, biological, and climatic processes over millennia, serves as the foundation for terrestrial ecosystems and provides vital ecosystem services essential for human well-being. Soil serves as a medium for plant growth, providing nutrients, water, and physical support for roots. It also acts as a habitat for countless microorganisms, insects, and small animals, contributing to soil fertility, biodiversity, and ecological resilience. Additionally, soil plays a crucial role in regulating the hydrological cycle by absorbing, storing, and filtering water, thereby preventing erosion, flooding, and groundwater contamination. Furthermore, soil serves as a carbon sink, sequestering carbon dioxide from the atmosphere and helping mitigate climate change. Given its finite nature and susceptibility to degradation from human activities such as deforestation, urbanization, and intensive agriculture, preserving and restoring soil health is paramount for ensuring food security, environmental sustainability, and the long-term viability of terrestrial ecosystems.

c) Explain an indirect use value of biodiversity.

An indirect use value of biodiversity refers to the benefits derived from biodiversity that are not directly exploited or consumed by humans but indirectly contribute to human well-being and ecosystem functioning. One example of an indirect use value of biodiversity is the role of diverse plant and animal species in pollination services. Pollinators such as bees, butterflies, birds, and bats play a crucial role in the reproduction of flowering plants by transferring pollen between flowers, facilitating fertilization and fruit and seed production. This process is

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essential for the reproduction of many food crops, including fruits, vegetables, nuts, and oilseeds, which rely on pollination for their yields. Without pollinators, agricultural productivity would decline, leading to reduced crop yields, increased food prices, and food insecurity. Additionally, pollination services provided by diverse pollinator species contribute to the maintenance of natural ecosystems, promoting plant diversity, ecosystem stability, and resilience to environmental changes. Therefore, conserving biodiversity and protecting pollinator habitats are essential not only for safeguarding ecosystem functioning but also for ensuring global food security and human well-being.

d) “Species diversity is the most visible component of Biodiversity.” Explain

Species diversity, often considered the most visible component of biodiversity, refers to the variety and abundance of different species present in a particular ecosystem or geographical area. It encompasses the richness of plant, animal, microbial, and fungal species, as well as the distribution patterns and ecological roles they fulfill within ecosystems. Species diversity is readily observable and quantifiable, making it a tangible indicator of ecosystem health and resilience. High levels of species diversity are indicative of a well-functioning and robust ecosystem, where multiple species interact and coexist, forming complex ecological networks and providing a wide range of ecosystem services. Species diversity plays a critical role in maintaining ecosystem stability, productivity, and resilience to environmental disturbances such as climate change, habitat loss, and invasive species. Additionally, species diversity has intrinsic value, representing the culmination of millions of years of evolutionary history and serving as a source of aesthetic, cultural, and scientific interest. Therefore, understanding and conserving species diversity are essential for preserving the integrity and functionality of ecosystems and ensuring the long-term sustainability of life on Earth.

e) Differentiate between food chain and food web.

Food chains and food webs are two interconnected concepts that describe the flow of energy and nutrients through ecosystems, but they differ in complexity and scope. A food chain is a linear sequence of organisms arranged in hierarchical order, depicting the transfer of energy and nutrients from one trophic level to another. It typically starts with producers, such as plants or algae, which are consumed by herbivores (primary consumers), which, in turn, are eaten by carnivores (secondary consumers), and so on. Each link in the food chain represents a feeding

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relationship between a predator and its prey, with energy decreasing as it moves up the chain due to losses through respiration, metabolism, and heat.

a food web is a more intricate and interconnected network of multiple food chains within an ecosystem, illustrating the complex interactions and interdependencies among various species. Unlike a linear food chain, a food web includes multiple interconnected trophic levels, with organisms occupying multiple roles as both predators and prey. Additionally, a food web incorporates omnivores, detritivores, and decomposers, which play crucial roles in recycling nutrients and maintaining ecosystem balance. Overall, while a food chain provides a simplified representation of energy flow within an ecosystem, a food web offers a more comprehensive understanding of the intricate relationships and dynamics that govern ecosystem structure and function.

PART-B

6. Explain the need for people's participation in environmental conservation with suitable case studies. 8

Environmental conservation necessitates the active engagement and participation of local communities, stakeholders, and individuals to foster sustainable practices, protect natural resources, and mitigate environmental degradation. People's participation in conservation efforts is crucial for several reasons, including fostering stewardship, promoting community resilience, and ensuring the long-term viability of ecosystems. Through suitable case studies, the significance of people's participation in environmental conservation becomes apparent.

Case Study: Chipko Movement, India The Chipko Movement, originating in the Himalayan region of India in the 1970s, exemplifies the power of grassroots activism and community involvement in forest conservation. In response to deforestation and commercial logging activities threatening their livelihoods and ecosystems, local villagers, primarily women, embraced non-violent resistance by hugging trees and forming human chains to protect them from being felled. Their actions not only raised awareness about the importance of forests for water security, soil conservation, and biodiversity but also led to policy changes and the establishment of community-based forest management initiatives. The Chipko Movement showcased the effectiveness of bottom-up approaches to conservation and highlighted the symbiotic relationship between local communities and forest ecosystems.

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Case Study: Community-based Marine Conservation, Philippines In the Philippines, community-based marine conservation initiatives, such as marine protected areas (MPAs) and coastal resource management programs, have empowered coastal communities to take ownership of their marine resources and implement sustainable fishing practices. One notable example is the Tubbataha Reefs Natural Park, a UNESCO World Heritage Site managed by local stakeholders in collaboration with government agencies and non-profit organizations. Through community patrols, reef monitoring, and sustainable tourism activities, the Tubbataha Reefs have become a model for effective marine conservation, supporting thriving coral reefs, fish populations, and ecotourism opportunities. The success of community-based marine conservation efforts in the Philippines underscores the importance of local knowledge, participation, and cooperation in safeguarding marine biodiversity and coastal ecosystems.

Case Study: Agroforestry in Africa Agroforestry practices, which integrate trees and shrubs into agricultural landscapes, offer multiple benefits for both people and the environment. In Africa, initiatives such as the Farmer-Managed Natural Regeneration (FMNR) approach have empowered farmers to restore degraded lands, enhance soil fertility, and increase agricultural productivity through participatory agroforestry techniques. By involving farmers in decision-making processes, providing training and technical assistance, and promoting indigenous knowledge, FMNR has enabled communities to reclaim barren landscapes, combat desertification, and improve food security. The success of agroforestry initiatives in Africa demonstrates the transformative potential of engaging local communities as active agents of environmental restoration and sustainable land management.

Case Study: Community Forest Management, Nepal In Nepal, community forest management has emerged as a successful model for biodiversity conservation, poverty alleviation, and sustainable development. Since the 1970s, the government has devolved forest management responsibilities to local communities through the formation of Community Forest User Groups (CFUGs), granting them rights to harvest forest resources sustainably while enforcing rules to prevent overexploitation and degradation. This decentralized approach to forest governance has empowered communities to protect and manage their forests effectively, resulting in increased forest cover, improved watershed management, and enhanced livelihoods for rural populations. The case of community forest management in Nepal illustrates how participatory approaches can foster environmental stewardship, social cohesion, and economic resilience at the local level.

the case studies presented above highlight the indispensable role of people's participation in environmental conservation efforts. By involving local communities, stakeholders, and

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individuals as active partners in conservation initiatives, we can harness local knowledge, foster stewardship, and promote sustainable practices that benefit both people and the planet. From grassroots movements to community-based resource management, the collective efforts of individuals and communities are essential for safeguarding biodiversity, protecting ecosystems, and building resilient and sustainable societies for future generations.

7. Explain the relevance of wetland with respect to nature reserves at the global level. 7

Wetlands, encompassing a diverse array of ecosystems such as marshes, swamps, bogs, and mangroves, are of paramount importance in the context of nature reserves at the global level. These unique and ecologically rich habitats provide numerous benefits to both humans and the environment, making them integral components of protected areas and nature reserves worldwide. Understanding the relevance of wetlands within nature reserves requires an exploration of their ecological significance, ecosystem services, and conservation challenges.

Biodiversity Hotspots: Wetlands support exceptionally high levels of biodiversity, serving as vital habitats for a wide range of plant and animal species. These ecosystems are home to numerous endemic and migratory species, including waterfowl, amphibians, fish, and wetland-dependent mammals. Wetlands also provide breeding grounds, nurseries, and foraging areas for many species, contributing to global biodiversity conservation efforts. Preserving wetlands within nature reserves helps safeguard these critical habitats and protect vulnerable and endangered species from habitat loss, degradation, and extinction.

Ecosystem Services: Wetlands provide a multitude of ecosystem services that are essential for human well-being and ecological balance. They play a crucial role in regulating water quantity and quality, acting as natural buffers against floods, droughts, and water pollution. Wetlands also enhance water filtration and purification, replenish groundwater reserves, and stabilize shorelines, thereby mitigating the impacts of climate change and natural disasters. Additionally, wetlands support nutrient cycling, carbon sequestration, and climate regulation, contributing to the overall health and resilience of ecosystems. By conserving wetlands within nature reserves, we can maintain and enhance these ecosystem services for present and future generations.

Carbon Sequestration and Climate Change Mitigation: Wetlands are significant carbon sinks, capable of storing vast amounts of carbon dioxide (CO₂) in their soils and vegetation. Peatlands, in particular, store more carbon per unit area than any other terrestrial ecosystem,

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making them critical in mitigating climate change. Preserving and restoring wetlands within nature reserves can help prevent the release of stored carbon into the atmosphere, reduce greenhouse gas emissions, and enhance the resilience of ecosystems to climate variability. Furthermore, protecting wetlands can contribute to international climate change mitigation efforts, such as those outlined in the Paris Agreement, by conserving and restoring blue carbon ecosystems.

Water Resources and Food Security: Wetlands play a vital role in supporting agricultural productivity, food security, and livelihoods for millions of people worldwide. They provide essential services such as water storage, irrigation, and nutrient cycling, which are crucial for sustaining crop yields and ensuring food security in water-scarce regions. Wetlands also support fisheries, aquaculture, and non-timber forest products, providing valuable sources of protein, income, and livelihood opportunities for local communities. By incorporating wetlands into nature reserves and protected areas, we can ensure the sustainable management of water resources, promote agricultural resilience, and support sustainable livelihoods for communities dependent on wetland ecosystems.

Cultural and Recreational Values: Wetlands hold significant cultural, aesthetic, and recreational value for communities worldwide, serving as sites for spiritual practices, cultural traditions, and outdoor recreation. They are often revered as sacred places, cultural heritage sites, and sources of inspiration for art, literature, and folklore. Wetlands also offer opportunities for eco-tourism, birdwatching, hiking, and wildlife viewing, attracting visitors from around the world and stimulating local economies. Preserving wetlands within nature reserves not only protects these cultural and recreational assets but also fosters appreciation and stewardship of natural heritage among communities and visitors alike.

Threats and Conservation Challenges: Despite their ecological importance, wetlands face numerous threats and conservation challenges at the global level. These include habitat loss and degradation due to urbanization, agriculture, infrastructure development, and industrial pollution. Wetlands are also vulnerable to invasive species, overexploitation, climate change, and sea-level rise, which can disrupt ecosystem functions and alter hydrological regimes. Additionally, wetlands are often undervalued and marginalized in policy and decision-making processes, leading to inadequate protection and management measures. Addressing these threats and challenges requires concerted efforts at local, national, and international levels to promote wetland conservation, restoration, and sustainable use.

wetlands play a critical role in nature reserves at the global level, providing essential ecosystem services, supporting biodiversity, and benefiting human societies in myriad ways. By

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recognizing the ecological significance of wetlands and integrating them into protected areas and conservation strategies, we can safeguard these invaluable habitats, promote sustainable development, and ensure the long-term health and resilience of ecosystems worldwide.

8. Explain the objectives of the Environment Protection Act of 1986 and its role in environmental conservation. 7

The Environment Protection Act (EPA) of 1986 is a landmark legislation enacted by the Government of India with the primary objective of protecting and improving the quality of the environment and preventing and abating environmental pollution. The Act provides a comprehensive framework for environmental governance, regulation, and enforcement, outlining key objectives and mechanisms to address environmental challenges across various sectors. Understanding the objectives of the EPA and its role in environmental conservation is crucial for promoting sustainable development and safeguarding environmental resources.

Prevention and Control of Pollution: One of the central objectives of the Environment Protection Act is to prevent and control environmental pollution, including air, water, and soil pollution, noise pollution, and hazardous waste management. The Act empowers the central government to establish standards and guidelines for pollution control, regulate industrial emissions and effluents, and prescribe measures to prevent and mitigate pollution from industrial, commercial, and domestic activities. By setting clear regulatory frameworks and enforcing compliance with environmental standards, the EPA aims to minimize environmental degradation and protect public health and well-being.

Environmental Impact Assessment (EIA): The EPA mandates the conduct of environmental impact assessments (EIAs) for projects and activities likely to have significant adverse effects on the environment. EIAs are systematic evaluations of the potential environmental impacts of proposed projects, such as industrial developments, infrastructure projects, and mining activities, conducted to identify and mitigate adverse effects on ecosystems, biodiversity, and local communities. Through the EIA process, the EPA seeks to ensure that development projects are environmentally sustainable, socially responsible, and economically viable, promoting the integration of environmental considerations into decision-making processes.

Conservation and Management of Natural Resources: The Environment Protection Act emphasizes the conservation and sustainable management of natural resources, including forests, wildlife, biodiversity, and water resources. The Act provides for the protection of

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ecologically sensitive areas, wildlife habitats, and biodiversity hotspots through the establishment of national parks, wildlife sanctuaries, and protected areas. It also encourages the adoption of conservation measures, habitat restoration initiatives, and sustainable resource management practices to safeguard ecosystems, enhance biodiversity, and preserve natural heritage for future generations.

Public Participation and Awareness: The EPA recognizes the importance of public participation, awareness, and education in environmental conservation efforts. The Act promotes public involvement in environmental decision-making processes, encouraging stakeholders to participate in consultations, public hearings, and environmental impact assessments. It also mandates the dissemination of information, awareness campaigns, and environmental education programs to raise public awareness about environmental issues, rights, and responsibilities. By fostering transparency, accountability, and civic engagement, the EPA seeks to empower communities to advocate for environmental protection and participate in sustainable development initiatives.

Enforcement and Legal Remedies: The Environment Protection Act provides for stringent enforcement mechanisms and legal remedies to address violations of environmental laws and regulations. It empowers regulatory authorities, such as the Central Pollution Control Board (CPCB) and State Pollution Control Boards (SPCBs), to monitor compliance with environmental standards, conduct inspections, and take enforcement actions against polluting industries and violators. The Act also prescribes penalties, fines, and legal sanctions for non-compliance, environmental offenses, and damage to the environment, thereby deterring environmental violations and ensuring accountability.

the Environment Protection Act of 1986 plays a pivotal role in environmental conservation by addressing pollution, promoting sustainable development, and safeguarding natural resources. By setting clear objectives, establishing regulatory frameworks, and providing enforcement mechanisms, the EPA seeks to protect the environment, enhance public health and well-being, and promote the sustainable use of natural resources for present and future generations.

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9. Answer the following questions in about 150 words each. 4x4

a) How does the environment influence human health? Explain it in detail with suitable examples.

The environment plays a crucial role in shaping human health, influencing physical, mental, and social well-being in various ways. Firstly, air quality significantly impacts respiratory health. Exposure to air pollutants such as particulate matter, nitrogen oxides, sulfur dioxide, and ozone can lead to respiratory diseases such as asthma, chronic obstructive pulmonary disease (COPD), and lung cancer. For example, urban areas with high levels of air pollution often experience higher rates of respiratory illnesses among residents. Secondly, water quality is essential for preventing waterborne diseases. Contaminated water sources can harbor pathogens like bacteria, viruses, and parasites, leading to diarrheal diseases such as cholera, typhoid, and dysentery. Inadequate sanitation and poor hygiene practices exacerbate the risk of waterborne illnesses, particularly in developing countries with limited access to clean water and sanitation facilities. Additionally, exposure to environmental toxins, hazardous chemicals, and pollutants in food, water, and soil can contribute to chronic health conditions, developmental disorders, and reproductive health issues. For instance, heavy metals like lead and mercury can impair neurological development in children and cause cognitive deficits and behavioral disorders. The environment plays a significant role in determining human health outcomes, highlighting the importance of environmental conservation and public health interventions.

b) Explain the problems associated with improper waste disposal and its impact on humans.

Improper waste disposal poses significant environmental and public health risks, contributing to pollution, disease transmission, and ecosystem degradation. One of the primary problems associated with improper waste disposal is the contamination of soil, water, and air with hazardous chemicals and pollutants. Open dumping of solid waste releases toxic substances, heavy metals, and organic pollutants into the environment, contaminating groundwater sources and surface water bodies. As a result, communities living near improperly managed waste sites are at increased risk of exposure to harmful substances, leading to adverse health effects such as respiratory illnesses, skin diseases, and gastrointestinal disorders. Moreover, decomposing

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organic waste generates methane gas, a potent greenhouse gas that contributes to climate change and global warming. Improper waste disposal also attracts pests and vectors such as rodents, flies, and mosquitoes, which can transmit infectious diseases to humans, including dengue fever, malaria, and leptospirosis. Furthermore, burning of waste in open dumps or unregulated incinerators releases toxic fumes and air pollutants, exacerbating respiratory problems and respiratory diseases among nearby populations. In conclusion, addressing the problems associated with improper waste disposal is essential for protecting public health, preserving environmental quality, and promoting sustainable development. Implementing proper waste management practices, including waste reduction, recycling, composting, and safe disposal methods, can mitigate the adverse impacts of waste on human health and the environment.

c) Acid rain is considered one of the major global issues. Explain acid rain and its effects.

Acid rain is a form of precipitation that is characterized by high levels of acidity, primarily caused by atmospheric pollutants such as sulfur dioxide (SO₂) and nitrogen oxides (NO_x) emitted from human activities like industrial processes, vehicle emissions, and fossil fuel combustion. When sulfur dioxide and nitrogen oxides react with water vapor, oxygen, and other chemicals in the atmosphere, they form sulfuric acid (H₂SO₄) and nitric acid (HNO₃), which then fall to the earth's surface as acid rain, snow, fog, or hail. Acid rain can have detrimental effects on the environment, ecosystems, and human health. Firstly, acid rain can cause damage to forests and vegetation by leaching essential nutrients like calcium and magnesium from the soil, disrupting nutrient cycles, and weakening plant roots. This can lead to the loss of biodiversity, decline in plant growth, and increased susceptibility to diseases and pests. Secondly, acid rain can acidify freshwater bodies such as lakes, rivers, and streams, threatening aquatic life and ecosystems. Acidic water can harm fish, amphibians, and aquatic plants by damaging their gills, scales, and tissues, and altering the pH balance of aquatic habitats. This can lead to fish kills, decline in species diversity, and loss of critical habitats. Furthermore, acid rain can corrode buildings, infrastructure, and cultural heritage sites made of limestone, marble, and metal, causing structural damage and degradation.

acid rain is a significant global issue that requires collective efforts to mitigate its impacts and address its root causes through pollution control measures and sustainable practices.

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d) Explain the different parameters that can assess water quality as a consumption.

Assessing water quality for consumption involves evaluating various parameters to ensure that water meets regulatory standards and is safe for human consumption. Some key parameters used to assess water quality include:

pH Level: The pH level indicates the acidity or alkalinity of water. Drinking water should ideally have a pH level between 6.5 and 8.5 to prevent corrosion of pipes and minimize health risks.

Turbidity: Turbidity refers to the cloudiness or clarity of water caused by suspended particles and sediments. High turbidity levels can indicate contamination and affect water taste, odor, and appearance.

Total Dissolved Solids (TDS): TDS measures the concentration of dissolved minerals and salts in water. Elevated TDS levels can affect water taste and indicate potential health risks from excessive mineral intake.

Microbial Contamination: Microbial contamination, including bacteria, viruses, and parasites, poses significant health risks to consumers. Testing for fecal coliforms, E. coli, and other pathogens helps ensure water safety.

Chemical Contaminants: Chemical contaminants such as heavy metals, pesticides, and industrial pollutants can leach into water sources and pose health risks. Monitoring for chemical pollutants helps identify potential sources of contamination and protect public health.

Nutrient Levels: Nutrient levels, including nitrogen and phosphorus, can impact water quality and ecosystem health. Excessive nutrient runoff from agriculture and urban areas can lead to eutrophication, algal blooms, and water quality degradation.

these parameters and implementing appropriate water treatment and management strategies, authorities can ensure that drinking water meets quality standards and safeguards public health. Regular monitoring and testing of water sources are essential to identify potential risks and prevent waterborne diseases and contamination incidents.

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10. Explain the following terms in about 60 words each: 3x4

a) Environmental Justice

Environmental justice refers to the fair treatment and meaningful involvement of all people, regardless of race, ethnicity, socioeconomic status, or geographic location, in environmental decision-making, regulation, and policies. It addresses the disproportionate burden of environmental hazards, pollution, and environmental degradation experienced by marginalized communities, often referred to as environmental racism or environmental injustice. Environmental justice advocates strive to promote equity, empowerment, and community resilience by advocating for environmental policies and practices that prioritize the needs and concerns of vulnerable populations and ensure equal access to clean air, water, and a healthy environment for all.

b) Central Pollution Control Board (CPCB)

The Central Pollution Control Board (CPCB) is a statutory organization established under the Environment Protection Act of 1986 in India, tasked with coordinating and implementing environmental protection and pollution control measures at the national level. As the apex regulatory body for environmental management, the CPCB formulates policies, sets standards, conducts research and monitoring, and oversees enforcement activities to prevent and control pollution across various sectors, including air, water, and land. The CPCB works in collaboration with state pollution control boards and other stakeholders to address environmental challenges, promote sustainable development, and safeguard public health and the environment.

c) Smog

Smog is a type of air pollution characterized by a mixture of smoke and fog, typically occurring in urban areas with high levels of vehicular emissions, industrial activities, and atmospheric pollutants. Smog consists of fine particulate matter, ground-level ozone, nitrogen oxides, volatile organic compounds, and other pollutants, which can pose significant health risks to

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populations exposed to prolonged or high concentrations of smog. Short-term exposure to smog can cause respiratory symptoms, exacerbate asthma, and increase the risk of cardiovascular diseases, while long-term exposure can lead to chronic respiratory conditions, lung damage, and premature mortality.

d) Green House Gases.

Greenhouse gases (GHGs) are atmospheric gases that trap heat in the Earth's atmosphere, contributing to the greenhouse effect and global warming. Common greenhouse gases include carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), and fluorinated gases. GHGs are released into the atmosphere through natural processes such as volcanic eruptions and decomposition, as well as human activities such as fossil fuel combustion, deforestation, agriculture, and industrial processes. The accumulation of greenhouse gases in the atmosphere leads to the retention of heat, resulting in climate change, rising temperatures, sea level rise, extreme weather events, and disruptions to ecosystems and biodiversity. Addressing greenhouse gas emissions is essential for mitigating climate change and reducing its adverse impacts on the environment, economy, and society.

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