

Air Pollution



VISION IAS
INSPIRING INNOVATION

Pollutants

- PM2.5 (Particulate Matter having an aerodynamic diameter less than or equal to 2.5 μm),
- PM 10 (Particulate Matter size equal to or less than 10 micron)
- Sulphur Dioxide (SO_2),
- Nitrogen Dioxide (NO_2) and
- Carbon monoxide (CO),
- Ammonia (NH_3) Lead (Pb)
- Ozone (O_3), Benzene (C_6H_6)
- Benzo(a)pyrene (BaP)
- Arsenic (As) and
- Nickel (Ni)

(For sources of pollutants and their impact refer the handout).

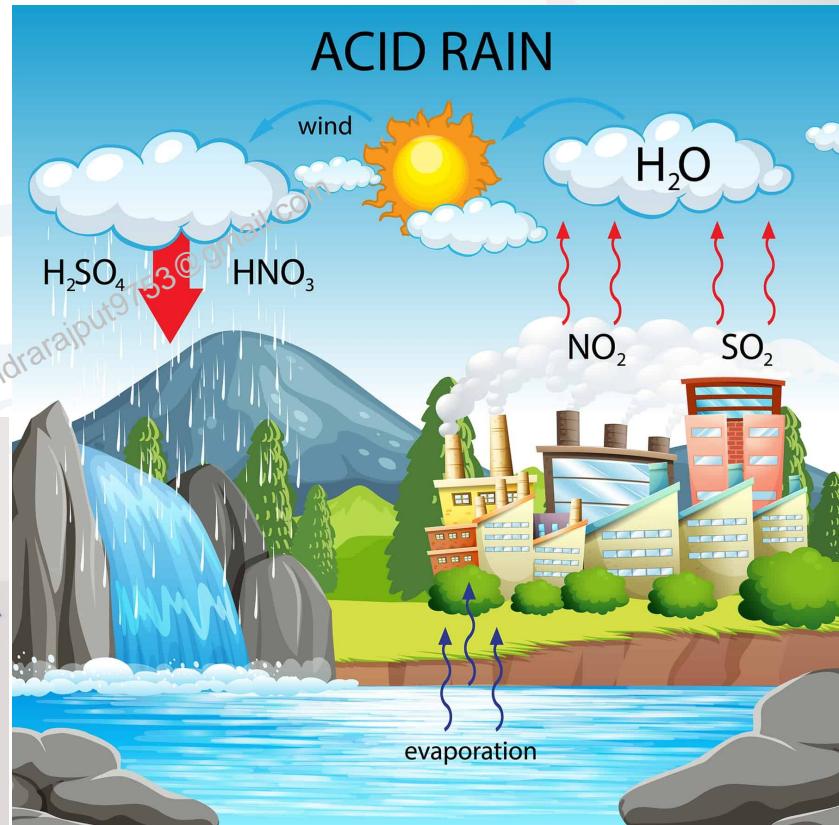
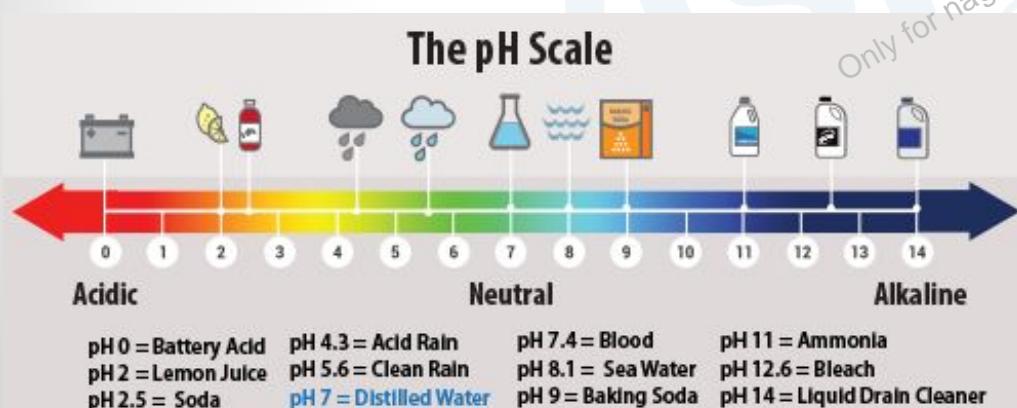
Pollutant	Time Weighted Average	Concentration in Ambient Air	
		Industrial, Residential, Rural, and Other Areas	Ecologically Sensitive Area (notified by Central Government)
Sulphur dioxide (SO_2), $\mu\text{g}/\text{m}^3$	Annual 24 hours	50 80	20 80
Nitrogen dioxide (NO_2), $\mu\text{g}/\text{m}^3$	Annual 24 hours	40 80	30 80
Particulate matter (< 10 μm) or PM_{10} , $\mu\text{g}/\text{m}^3$	Annual 24 hours	60 100	60 100
Particulate matter (< 2.5 μm) or $\text{PM}_{2.5}$, $\mu\text{g}/\text{m}^3$	Annual 24 hours	40 60	40 60
Ozone (O_3), $\mu\text{g}/\text{m}^3$	8 hours 1 hour	100 180	100 180
Lead (Pb), $\mu\text{g}/\text{m}^3$	Annual 24 hours	0.50 1.0	0.50 1.0
Carbon monoxide (CO), mg/m^3	8 hours 1 hour	02 04	02 04
Ammonia (NH_3), $\mu\text{g}/\text{m}^3$	Annual 24 hours	100 400	100 400
Benzene (C_6H_6), $\mu\text{g}/\text{m}^3$	Annual	05	05
Benzo(a)Pyrene (BaP) – particulate phase only, ng/m^3	Annual	01	01
Arsenic (As), ng/m^3	Annual	06	06
Nickel (Ni), ng/m^3	Annual	20	20

Pollutants

- Primary pollutant
 - directly from a source.
- Secondary pollutant
 - not directly emitted as such, but forms when other pollutants (primary pollutants) react in the atmosphere.
 - Examples: Ozone (O_3), which is formed when hydrocarbons (HC) and nitrogen oxides (NOx) combine in the presence of sunlight;
 - Acid rain, which is formed when Sulfur dioxide (SO_2) or nitrogen oxides (NOx) react with water.
 - Photochemical Smog
- Sources: Point and Non-Point

Acid Rain

- Any form of precipitation with acidic components, such as sulfuric or nitric acid that fall to the ground from the atmosphere in wet or dry forms.
- Acidic particles and gases can also deposit from the atmosphere in the absence of moisture as dry deposition.

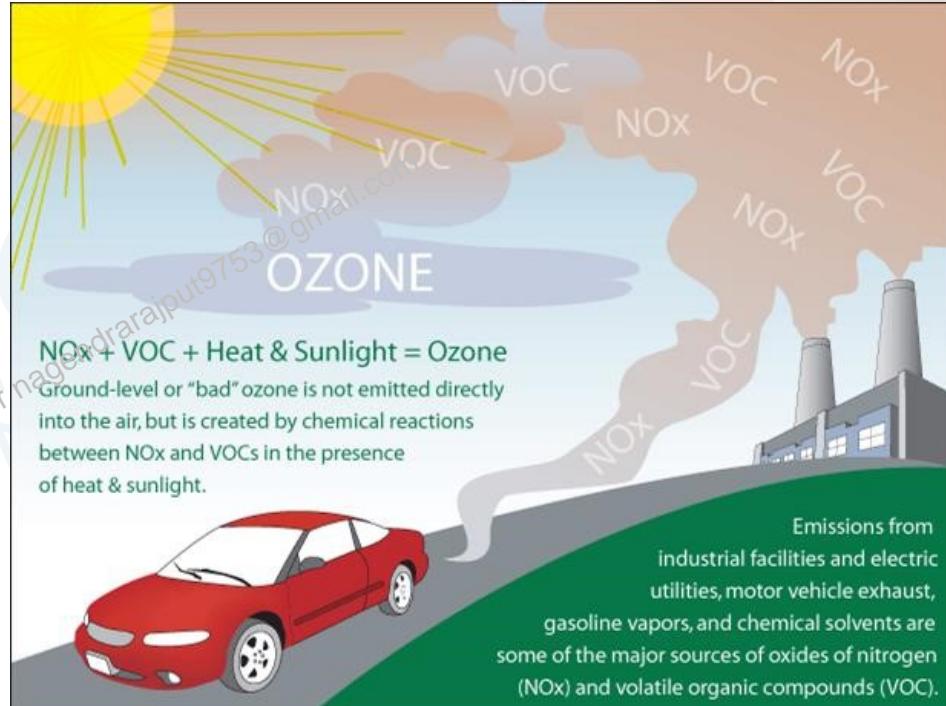


Acid Rain

- It can lower the pH of these bodies of water, making them more acidic,
- harmful to fish and other aquatic life by disrupting their behavior, damaging their bodies, or reducing their reproductive success.
- Acid rain can also harm forests, killing trees and damaging the leaves, stems, and roots of plants.
- respiratory problems and other health issues among human beings.
- **Steps:** to minimize the emission of sulfur dioxide and nitrogen oxides into the atmosphere

Ozone Pollution

- Good vs Bad Ozone
- Tropospheric ozone is created by chemical reactions between oxides of nitrogen (NO_x) and volatile organic compounds (VOC).
- pollutants emitted by cars, power plants, industrial boilers, refineries, chemical plants, stubble burning and other sources chemically react in the presence of sunlight.



Ozone Pollution

- Exposure to high levels of ozone can cause respiratory problems, such as coughing, wheezing, and shortness of breath,
- it can also damage plants and reduce crop yields.
- It reduces photosynthesis.
- Steps:
 - National: Part of national ambient air quality standards
 - The 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (Gothenburg Protocol)
 - The Protocol sets national emission ceilings for 2010 up to 2020 for four pollutants: Sulphur (SO₂), nitrogen oxides (NO_x), volatile organic compounds (VOCs) and ammonia (NH₃).
 - one of the Eight Protocols under UNECE Convention on Long Range Transboundary Air Pollution
 - India is not a signatory.

Smog

- Smog is air pollution that reduces visibility.
- The term was first used in the early 1900s to describe a mix of smoke and fog.
- Classical smog is caused by the emission of smoke and sulfur dioxide from the burning of coal and other fossil fuels as well as from industrial processes such as metal smelting and refining.
- In many cities, classical smog has been largely replaced by photochemical smog.



Photochemical smog

- is a mixture of pollutants that are formed when nitrogen oxides and volatile organic compounds (VOCs) react to sunlight, creating a brown haze above cities.
- It tends to occur more often in summer, because that is when we have the most sunlight.
- Natural Sources:
 - bushfires, lightning and the microbial processes that occur in soil generate nitrogen oxides.
 - VOCs are produced from the evaporation of naturally-occurring compounds, such as terpenes, which are the hydrocarbons in oils that make them burn.
 - Eucalypts have also been found to release significant amounts of these compounds.

Photochemical smog

- Anthropogenic sources

- Nitrogen oxides are produced mainly from the combustion of fossil fuels, particularly in power stations and motor vehicles.
- VOCs are formed from the incomplete combustion of fossil fuels, from the evaporation of solvents and fuels, and from burning plant matter—such as backyard burning and wood-burning stoves.
- Vehicle emissions: These emissions contain nitrogen oxides (NOx) and volatile organic compounds (VOCs), which contribute to the formation of smog when they react with sunlight.
- Industrial emissions: Industrial activities, such as power plants and factories, also contribute to photochemical smog through the release of NOx and VOCs into the air.
- Solvents: Solvents used in painting, printing, and other processes can release VOCs into the air, contributing to the formation of smog.
- Tobacco smoke: Tobacco smoke contains many chemicals that can contribute to photochemical smog, including NOx and VOCs.

Photochemical smog

- $\text{NO}_2 + \text{sunlight} = \text{NO} + \text{O}$
- $\text{O} + \text{O}_2 = \text{O}_3$
- $\text{O}_3 + \text{NO} = \text{NO}_2 + \text{O}_2$
- $\text{NO}_2 + \text{R} = \text{products such as PAN}$ ($\text{R} = \text{hydrocarbons}$)
(PAN = peroxyacetyl nitrate)
- $\text{NO} + \text{ROx} = \text{NO}_2 + \text{other products}$



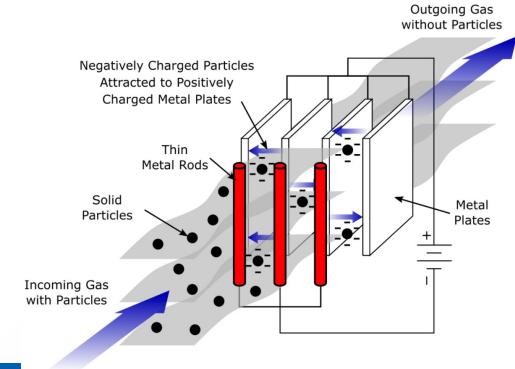
Photochemical smog

Steps:

- Reduction of nitrogen oxide The main method of lowering the levels of nitrogen oxides is by a process called 'catalytic reduction', which is used in industry and in motor vehicles.
- a catalytic converter fitted to a car's exhaust system will convert much of the nitric oxide from the engine exhaust gases to nitrogen and oxygen.
- Temperature also has an effect on emissions—the lower the temperature of combustion, the lower the production of nitrogen oxides.
- Reduction of VOCs There are various ways to reduce VOC emissions from motor vehicles. These include the use of liquefied petroleum gas (LPG) or compressed natural gas (CNG) rather than petrol

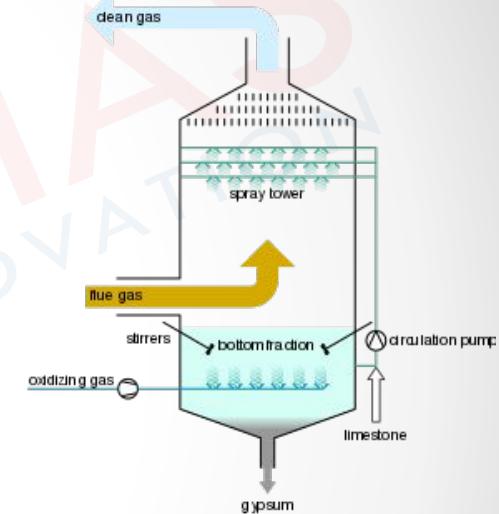
Control of Industrial Pollution

- **Cleaner Fuel:**
 - LNG
 - Clean Coal Technologies
 - Coal Gasification
- Filters such as **baghouse filters** to remove PM from gases
- **Electrostatic precipitators:**
 - The emanating dust is charged with ions and the ionized particulate matter is collected on an oppositely charged surface and removed.
- **Inertial collectors** such as Cyclone dust collectors.
- **Absorption by Scrubbers:** transfer of a gaseous pollutant from the air into a contacting liquid, such as water.
 - Liquid serve as a solvent for the pollutant or to capture it by means of a chemical reaction.

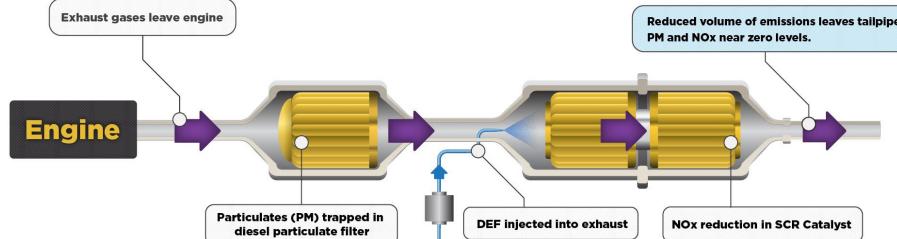


Control of Industrial Pollution

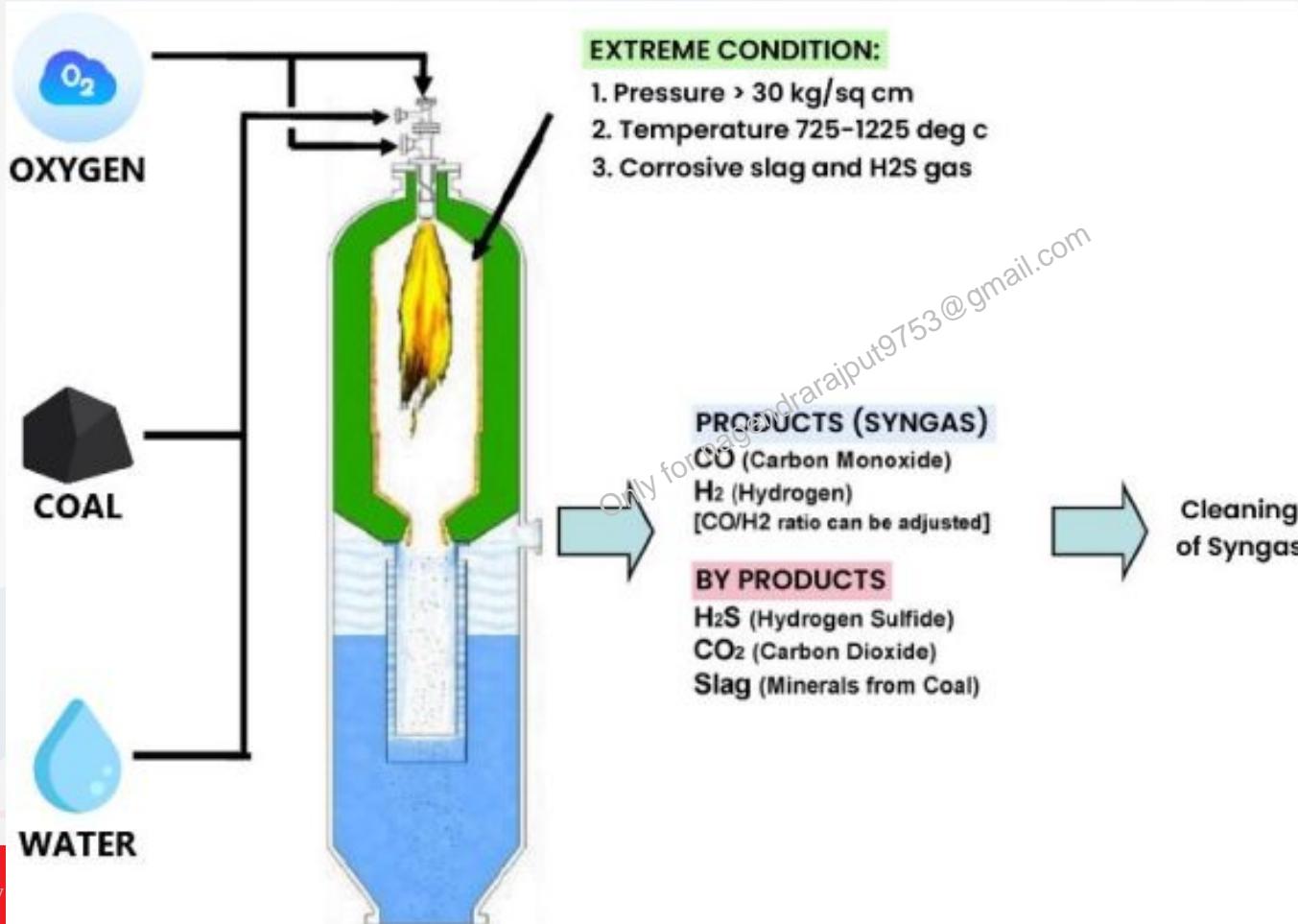
- **Flue gas Desulphurization:** from Power plants
 - wet scrubbing or dry scrubbing.
 - In wet FGD: The sulfur dioxide dissolves in or reacts with the absorbent and becomes trapped in it.
 - In dry FGD systems, the absorbent is dry pulverized lime or limestone; once absorption occurs, the solid particles are removed by means of baghouse filters
- **Carbon Sequestration**
- **Selective Catalytic / Non-catalytic Reduction:** converting nitrogen oxides (NOx) with the aid of a catalyst into diatomic N₂ and H₂O.



Diesel Emissions Control System



BASICS OF COAL GASIFICATION PROCESS



Indoor Air Pollution

- Indoor air pollution refers to the contamination of the air inside homes, offices, and other buildings.
- **Sources:** including traditional chulhas, unclean energy sources, tobacco smoke, mold, household cleaning products, pesticides, and radon gas.
- **Impact:** including respiratory problems, allergies, and cancer.
- Solution:
 - to keep the indoor environment clean and well-ventilated,
 - use natural and low-toxic cleaning products,
 - fix any water leaks or moisture issues to prevent mold growth.
 - Awareness
- Steps:
 - Pradhan Mantri Ujjwala Yojana
 - Unnat Chulha Abhiyan
 - Promoting solar cookers
 - National Biogas and Manure Management Programme

Measures to Tackle

- Institutional Measures:
 - CPCB and SPCB: Constituted under the Water (Prevention and Control of Pollution) Act 1974, to implement the environmental laws and rules.
 - Also derive power from Air (Prevention and Control of Pollution) Act 1981.
- National clean air program
- Bharat Stage VI
- Fly ash utilizations guidelines
- Emission norms for Thermal power plants
- Electric Vehicles
- Hydrogen Mission
- Ban on Stubble burning: Utilization of Stubble

NCAP

National Clean Air Programme (NCAP)

- A comprehensive national level strategy
- launched in 2019 with the goal of reducing air pollution in the country by 20-30% by 2024.
- It aims to improve air quality in 102 cities, which are identified as non-attainment cities,
 - cities that do not meet the National Ambient Air Quality Standards.
- The Centre has set a new target of a 40% reduction in particulate matter concentration in cities covered under the National Clean Air Programme (NCAP) by 2026 in 131 non-attainment cities



NCAP

- NCAP details seven mitigation actions:
 - Web-based, three-tier mechanism - to monitor any form of non-compliance.
 - Extensive Plantation Drive
 - Technology Support: Clean Technologies with potential for air pollution prevention and mitigation
 - Regional and Transboundary Plan
 - Sectoral Interventions: such as e-mobility, power sector emissions, indoor air pollution, waste management etc.
 - City Specific Air Quality Management Plan
 - exploring detailed funding mechanism by states.

NCAP

- Knowledge and Database Augmentation
 - Air Quality Monitoring Network
 - Air pollution health & economic impact studies
 - International Cooperation
 - Review of Ambient Air Quality Standards and Emission Standards.
- Institutional Strengthening
 - National Apex Committee at the MoEF&CC and State-level Apex Committee under the chief secretaries in various states.
 - Public Awareness and Education:
 - Operationize the NPL-India Certification Scheme
 - Air-Quality Forecasting System (AQFS): as a state-of-the-art modelling system
 - Network of Technical Institutions- Knowledge Partners

Bharat stage VI

- to regulate the emissions of air pollutants from vehicles.
- It came into effect on April 1, 2020.
- BS-VI is the equivalent of the Euro 6 emission standards followed in Europe.
- it reduces the allowable levels of several air pollutants such as CO, nitrogen oxides (NOx), particulate matter (PM), and hydrocarbons (HC).
- Applicable to all vehicles including cars, motorcycles, and commercial vehicles such as buses and trucks.
- vehicles must be equipped with advanced emission control technologies such as diesel particulate filters, selective catalytic reduction systems, and lean NOx traps.

Fly ash utilization

- by-product of burning coal in thermal power plants
- contains oxides of silica, alumina and calcium. Elements like Arsenic, Boron, Chromium, lead etc.
- Utility of Fly ash:
 - Agriculture: Improves holding capacity of water
 - Construction work: manufacturing of Portland cement, bricks/blocks/tiles manufacturing, road embankment construction and low-lying area development
 - Absorbents that are suitable for purification of waste gases
- Steps:
 - Fly Ash Notification 2021 was issued under the Environment (Protection) Act 1986: Centre has made it mandatory for such plants to ensure 100% utilization of ash in an eco-friendly manner.
 - **the non-compliant power plants will be imposed with an environmental compensation** of Rs 1,000 per tonne
 - **CPCB will be use the amount towards the safe disposal of the unutilised ash.**
 - **power plants will have to deliver fly ash at project sites free of cost.**
 - National Green Tribunal (NGT) directed the constitution of a 'Fly Ash Management and Utilisation Mission.

Thermal Power Plants

- Emission norms by CPCB regarding liquid effluents, Pollutants such as PM, SO₂, NO_x, Mercury
- Central Pollution Control Board (CPCB) to categorise thermal power plants (TPPs) in three categories on the basis of their location
 - Category A: TPP within 10 kilometres of the National Capital Region (NCR) and in cities with more than 10 lakh population to comply with new emission norms by the end of 2024.
 - Category B: In non-attainment cities (those cities which are not meeting National Ambient Air Quality Standards) and those within 10 kilometres of critically polluted areas have to meet the norms by December 31, 2025.
 - Category C: Coal-fired power plants in the rest of the areas have to comply with the new standards by December 31, 2026.
- Penalty provisions: In case of non-compliance, a penalty of up to 0.20 rupees per unit
- TPPs declared to retire before December 31, 2025 are not required to meet the specified norms

Quantifying Air Pollution

- National Ambient Air Quality
- National Air Quality Index

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Delhi NCR Pollution

- Sources
- Geographical Factors
- Impact of Stubble burning
 - Punjab Preservation of Subsoil Water Act
- Steps:
 - Graded Response Action Plan: Commission on Air Quality Management (CAQM) replaced Environment Pollution (Prevention & Control) Authority (EPCA).
 - Ban on Crop Residue
 - National Policy for Management of Crop Residue
 - Pradhan Mantri JI-VAN (Jaiv Indhan- Vatavaran Anukool fasal awashesh Nivarana) Yojana.
 - Smog Towers

Noise Pollution

- Sound or Noise Pollution is excessive or unwanted noise that can have negative impacts on the environment and human health.
- **Sources:** traffic, construction, aircraft, loudspeakers and industrial and commercial activities.
- **Impact:** increased blood pressure, loss of temper, decrease in work efficiency, loss of hearing, mental depression
- prescribed optimum noise level by WHO
 - as 45 dB by day and 35 dB by night.
- **Anything above 80 dB** is hazardous



Noise Pollution

- The Government of India has taken a number of steps to reduce noise pollution, including the following:
 - **The Noise Pollution (Regulation and Control) Rules, 2000 (under Environment protection Act, 1986)** : These rules establish standards for noise levels in various areas and provide guidelines for the prevention, control, and abatement of noise pollution.
 - **The Motor Vehicles Act, 1988**: This act regulates the noise levels of vehicles and imposes penalties for violations.
 - **The Air (Prevention and Control of Pollution) Act, 1981**: This act establishes standards for noise levels in the environment and provides for the prevention, control, and abatement of air pollution, including noise pollution.
 - **The Noise Monitoring and Measurement Rules, 2009**: These rules provide guidelines for the monitoring and measurement of noise levels in various areas.

Noise Pollution

More Steps:

- Limit the use of loud equipment and vehicles, such as by using quiet power tools and choosing low-noise appliances.
- Use noise barriers and insulation, such as soundproof windows and walls, to reduce the transmission of noise.
- Follow noise regulations, such as those related to construction and vehicular traffic.
- Plant trees and other vegetation, which can absorb and deflect sound waves.
- Use earplugs or noise-cancelling headphones to reduce the impact of noise when you are in a loud environment.
- Turn down the volume on music and other audio devices, and use headphones instead of speakers.
- Support organizations that work to reduce noise pollution and advocate for responsible noise practices.
- Educate others about the negative impacts of noise pollution and ways to reduce it.

Consider the following :

1. Carbon dioxide
2. Oxides of Nitrogen
3. Oxides of Sulphur

Which of the above is/are the emission/ emissions from coal combustion at thermal power plants ?

- (a) 1 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

2011

Acid rain is caused by the pollution of environment by

- (a) carbon dioxide and nitrogen
- (b) carbon monoxide and carbon dioxide
- (c) ozone and carbon dioxide
- (d) nitrous oxide and sulphur dioxide

2013

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Photochemical smog is a resultant of the reaction among

- (a) NO_2 , O_3 and peroxyacetyl nitrate in the presence of sunlight
- (b) CO, O_2 and peroxyacetyl nitrate in the presence of sunlight
- (c) CO, CO_2 and NO_2 at low temperature
- (d) high concentration of NO_2 , O_3 and CO in the evening

2013

Which of the following are some important pollutants released by steel industry in India?

1. Oxides of sulphur
2. Oxides of nitrogen
3. Carbon monoxide
4. Carbon dioxide

Select the correct answer using the code given below.

2014

- (a) 1, 3 and 4 only
- (b) 2 and 3 only
- (c) 1 and 4 only
- (d) 1, 2, 3 and 4

There is some concern regarding the nanoparticles of some chemical elements that are used by the industry in the manufacture of various products. Why?

1. They can accumulate in the environment, and contaminate water and soil.
2. They can enter the food chains.
3. They can trigger the production of free radicals.

Select the correct answer using the code given below.

- (a) 1 and 2 only
- (b) 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

2014

With reference to 'fly ash' produced by the power plants using coal as fuel, which of the following statements is/are correct?

1. Fly ash can be used in the production of bricks for building construction.
2. Fly ash can be used as a replacement for some of the Portland cement contents of concrete.
3. Fly ash is made up of silicon dioxide and calcium oxide only, and does not contain any toxic elements.

Select the correct answer using the code given below.

- (a) 1 and 2
- (b) 2 only
- (c) 1 and 3
- (d) 3 only

2015

In the cities of our country, which among the following atmospheric gases are normally considered in calculating the value of Air Quality Index?

1. Carbon dioxide
2. Carbon monoxide
3. Nitrogen dioxide
4. Sulfur dioxide
5. Methane

2016

Select the correct answer using the code given below.

- (a) 1, 2 and 3 only
- (b) 2, 3 and 4 only
- (c) 1, 4 and 5 only
- (d) 1, 2, 3, 4 and 5

Consider the following statements :

1. Climate and Clean Air Coalition (CCAC) to Reduce Short Lived Climate Pollutants is a unique initiative of G20 group of countries.
2. The CCAC focuses on methane, black carbon and hydrofluorocarbons.

Which of the statements given above is/are correct ?

2017

- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 nor 2

2018

How is the National Green Tribunal (NGT) different from the Central Pollution Control Board (CPCB) ?

1. The NGT has been established by an Act whereas the CPCB has been created by an executive order of the Government.
2. The NGT provides environmental justice and helps reduce the burden of litigation in the higher courts whereas the CPCB promotes cleanliness of streams and wells, and aims to improve the quality of air in the country.

Which of the statements given above is/are correct ?

- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 nor 2

Consider the following :

- 1. Carbon monoxide**
- 2. Methane**
- 3. Ozone**
- 4. Sulphur dioxide**

Which of the above are released into atmosphere due to the burning of crop/biomass residue?

- (a) 1 and 2 only**
- (b) 2, 3 and 4 only**
- (c) 1 and 4 only**
- (d) 1, 2, 3 and 4**

2019

Which of the following are the reasons/factors for exposure to benzene pollution ?

1. Automobile exhaust
2. Tobacco smoke
3. Wood burning
4. Using varnished wooden furniture
5. Using products made of polyurethane

Select the correct answer using the code given below :

- (a) 1, 2 and 3 only
- (b) 2 and 4 only
- (c) 1, 3 and 4 only
- (d) 1, 2, 3, 4 and 5

2020

In rural road construction, the use of which of the following is preferred for ensuring environmental sustainability or to reduce carbon footprint ?

1. Copper slag
2. Cold mix asphalt technology
3. Geotextiles
4. Hot mix asphalt technology
5. Portland cement

Select the correct answer using the code given below :

- (a) 1, 2 and 3 only
- (b) 2, 3 and 4 only
- (c) 4 and 5 only
- (d) 1 and 5 only

2020

Consider the following statements :

1. Coal ash contains arsenic, lead and mercury.
2. Coal-fired power plants release sulphur dioxide and oxides of nitrogen into the environment.
3. High ash content is observed in Indian coal.

Which of the statements given above is/are correct ?

- (a) 1 only
- (b) 2 and 3 only
- (c) 3 only
- (d) 1, 2 and 3

2020

In the context of WHO Air Quality Guidelines, consider the following statements :

1. The 24-hour mean of $PM_{2.5}$ should not exceed $15 \mu\text{g}/\text{m}^3$ and annual mean of $PM_{2.5}$ should not exceed $5 \mu\text{g}/\text{m}^3$.
2. In a year, the highest levels of ozone pollution occur during the period of inclement weather.
3. PM_{10} can penetrate the lung barrier and enter the bloodstream.
4. Excessive ozone in the air can trigger asthma.

Which of the statements given above are correct ?

- (a) 1, 3 and 4
- (b) 1 and 4 only
- (c) 2, 3 and 4
- (d) 1 and 2 only

2022

Consider the following :

1. Carbon monoxide
2. Nitrogen oxide
3. Ozone
4. Sulphur dioxide

Excess of which of the above in the environment is/are cause(s) of acid rain ?

- (a) 1, 2 and 3
- (b) 2 and 4 only
- (c) 4 only
- (d) 1, 3 and 4

2022

Water Pollution

- Pollution of Water Bodies
- River Pollution
- Groundwater Pollution
- Sources: Point and Non-Point

Parameters used by CPCB to measure Water Quality

- Temperature
- Dissolved Oxygen
- pH
- Conductivity
- Bio-Chemical Oxygen demand
- Nitrate and Nitrite
- Fecal Coliform
- Total Coliform

BOD and COD

- Biological Oxygen Demand,
 - is a measure of the amount of oxygen that is consumed by bacteria as they break down organic matter in water.
 - BOD is an indication of the amount of organic matter present in water and is often used as a measure of water pollution.
- Chemical Oxygen Demand,
 - is a measure of the amount of oxygen that is required to chemically oxidize organic matter in water.
 - COD is an indication of the amount of organic matter present in water,
 - it also includes inorganic matter such as metals and nitrogen compounds that cannot be broken down by bacteria.
- both measured in milligrams of oxygen per liter of water (mg/L).
- The higher the BOD or COD level, the greater the amount of organic matter present in the water and the poorer the water quality.
- COD is higher than BOD because chemical oxidation is easier than BOD
- Example of chemicals in COD: potassium dichromate, potassium permanganate, copper sulfate, and titanium sulfate.

Nitrate and Nitrite

- Nitrate (NO_3) is a soluble compound that is found in fertilizers, animal manure, and other sources.
- Nitrite (NO_2) is a less stable compound that is produced when nitrate is reduced by bacteria.
- they can interfere with the oxygen-carrying capacity of the blood
 - Blue baby syndrome, also known as methemoglobinemia, is a condition that occurs when there is an excess of methemoglobin, a form of hemoglobin, in the blood. most commonly caused by high levels of nitrate in drinking water.
- can enter water through agricultural runoff, sewage discharges, and other sources.
- can be reduced through treatment methods such as denitrification, in which bacteria are used to convert the nitrogen compounds into harmless gases.

Coliform

- Coliform bacteria are found in the feces of warm-blooded animals, including humans.
- indicates the presence of other potentially harmful bacteria or pathogens that may have contaminated the water.
- Coliform bacteria can enter water through sewage discharges, agricultural runoff, and other sources.
- Coliform bacteria levels in water can be reduced through proper treatment and filtration.

Groundwater Pollution

- Sources:

- Chemical pollutants: Chemical pollutants, such as pesticides, herbicides, and fertilizers.
- Petroleum products: Leaks or spills of gasoline, oil, and other petroleum products
- Industrial waste: manufacturing and mining
- Septic systems: Improperly designed or maintained septic systems can leak or overflow
- Landfills: Landfills can leak chemicals and other pollutants
- Agricultural practices: The use of chemicals and animal manure
- Human waste: The improper disposal of human waste, such as sewage or diaper waste

Uranium Contamination

- Effects: thyroid cancer, blood cancer, depression, chronic kidneys disease etc.
- Sources:
 - sediment carried down from the Himalayas by streams or from uranium-rich granitic rocks.
 - Overuse of such aquifers
 - Increased solubility of Uranium in ground water: interaction with bicarbonate, oxidation (use of nitrates and other oxidizers)
- Way forward: Adsorption(TiO_2 , Activated Carbon), Precipitation [$(Fe(OH)_3$, $Al(OH)_3$, $Ti(OH)_4$ and $Ca_3(PO_4)_2$], Membranes, Nanofiltration and Reverse Osmosis
- As per Bureau of Indian Standard (BIS), maximum permissible limit of Uranium is 0.03 mg/l (as per WHO provisional guidelines)



River Pollution

- Causes and Sources:

- Agriculture runoff
- Industrial effluents
- Household waste
- Mining
- Heavy metal pollution
- Sand mining
- Deforestation

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Heavy Metals and impact

Metal	Sources	Toxic effects
Cadmium	coal, nuclear and coal power plant, batteries, ceramics, toys	Itai Itai disease
Chromium	Leather/tanner, thermal power plant, mining fertilizers, textile photography	Allergies, Bronchial asthma
Lead	Mining, coal, automobile, paper dyeing, petrochemicals	Learning disability, mental retardation
Mercury	Mining, paper and pulp, coal power plant, cement, electrical equipments, pesticides cosmetics	Minimata disease
Nickel	Mining, coal, power plant, phosphate fertilizers, chocolate, automobile electroplating	Dermatitis,Pneumonia
Uranium	Mining	Cancer
Zinc	Phosphate fertilizers, distillery, pharmaceuticals	Fever

Namami Gange

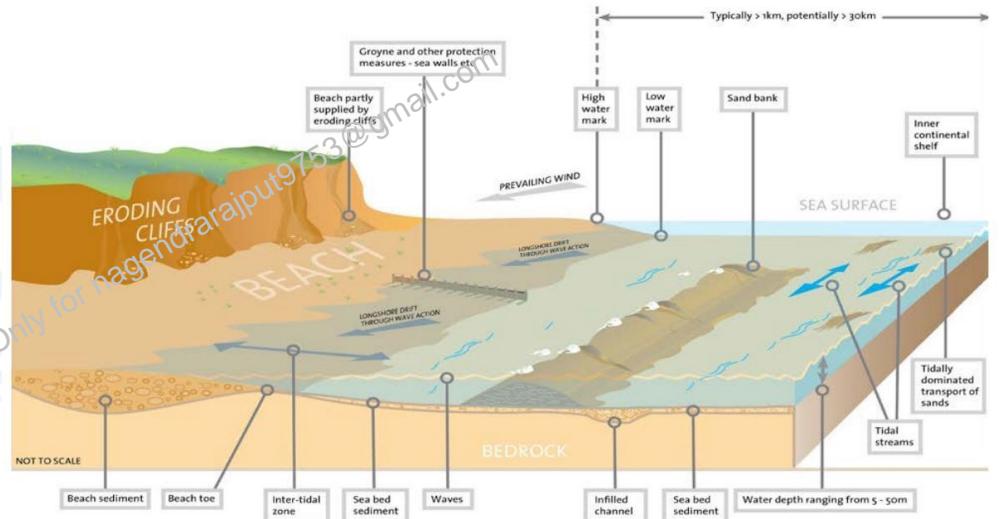
- effective abatement of pollution in Ganga and tributaries
- conservation and rejuvenation of River Ganga
 - Sewerage Treatment Infrastructure
 - Industrial Effluent Monitoring
 - River-Front Development
 - River-Surface Cleaning
 - Bio Diversity
 - Afforestation
 - Public Awareness
 - Ganga Gram
- Environment (Protection) Act, 1986: a five- tier structure has been envisaged at national, state and district level to take measures for prevention, control and abatement of environmental pollution in Ganga
- National Mission for Clean Ganga is registered as a society under the Societies Registration Act 1860.

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Sand Mining

- Sand – a minor mineral as per Mines and Mineral (Development and Regulation) Act, 1957
- Environmental Impact:
 - River course change
 - Bank Erosion
 - Flooding
 - Lowering of Groundwater table
 - Biodiversity loss
- Steps taken:
 - empowers **state governments** to frame rules
 - Districts to have comprehensive mining plan
 - Define the mining and no mining zones: Prefer abandoned stream channels
 - No Riverbed mining in Monsoon
 - Use of technology
 - Annual audit of mining lease
 - Online portal for sale and purchase of sand and river bed material

Figure 1: Key features and processes considered in a coastal impact study for aggregate dredging



Source: (BMAPA and The Crown Estate 2013 p.41)

Eutrophication

- water becomes enriched in nutrients, particularly phosphorus and nitrogen, leading to an increase in the growth of aquatic plants and algae.
- agricultural runoff and sewage discharge.
- Excessive eutrophication can have negative impacts on the ecosystem.
 - overabundance of algae can lead to oxygen depletion in the water,
 - can harm or kill other aquatic organisms.
 - can block sunlight from reaching deeper layers of the water, disrupting the normal functioning of the ecosystem.



Thermal Pollution

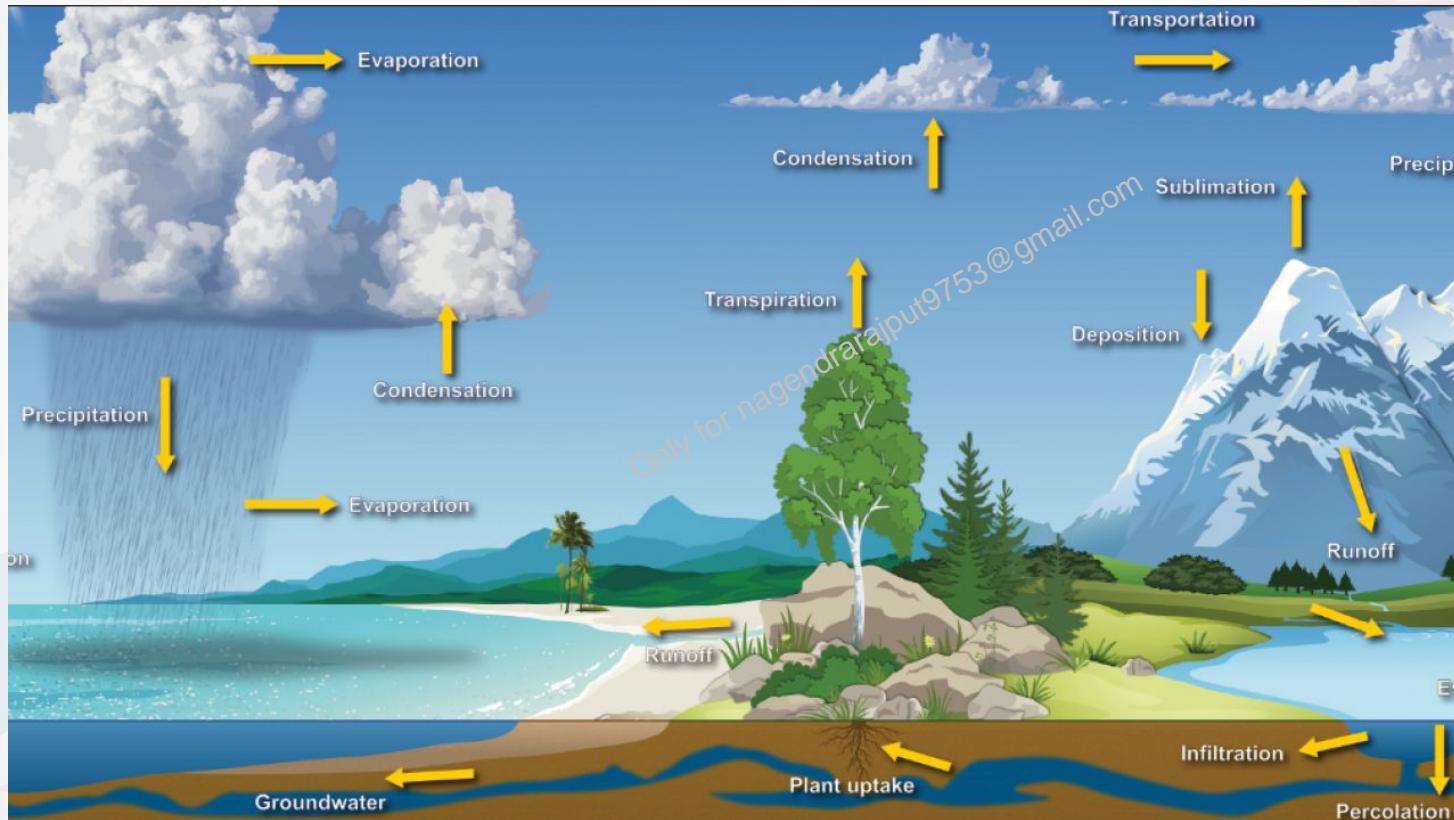
- The process of increasing the temperature of a natural body of water, as a result of human activity.
- This includes discharge of hot water from
 - power plants and industrial facilities,
 - the use of water for irrigation,
 - the operation of boats and other watercraft.
- The impacts of thermal pollution depend on the magnitude and duration of the temperature increase.
- It also depends upon sensitivity of the organisms in the affected ecosystem.



Thermal Pollution

- Impact:
 - Thermal pollution can be harmful to aquatic life by stressing or killing them, disrupting their behavior, or reducing their reproductive success.
 - resistance to diseases and parasites decreases.
 - Running away from predators or chasing prey becomes difficult.
- Steps:
 - minimize the use of water for cooling
 - recycle or reuse cooling water whenever possible
 - use the most efficient cooling technologies available
 - allow the water to cool before releasing into any receiving water body

Water Cycle



Water Sources

Water source	Water volume, in cubic miles	Water volume, in cubic kilometers	Percent of freshwater	Percent of total water
Oceans, Seas, & Bays	321,000,000	1,338,000,000	--	96.54
Ice caps, Glaciers, & Permanent Snow	5,773,000	24,064,000	68.7	1.74
Groundwater	5,614,000	23,400,000	--	1.69
<i>Fresh</i>	2,526,000	10,530,000	30.1	0.76
<i>Saline</i>	3,088,000	12,870,000	--	0.93
Soil Moisture	3,959	16,500	0.05	0.001
Ground Ice & Permafrost	71,970	300,000	0.86	0.022
Lakes	42,320	176,400	--	0.013
<i>Fresh</i>	21,830	91,000	0.26	0.007
<i>Saline</i>	20,490	85,400	--	0.006
Atmosphere	3,095	12,900	0.04	0.001
Swamp Water	2,752	11,470	0.03	0.0008
Rivers	509	2,120	0.006	0.0002
Biological Water	269	1,120	0.003	0.0001

Source:

<https://www.usgs.gov/special-topics/water-science-school/science/how-much-water-there-earth#:~:text=About%2071%20percent%20of%20the,Water%20is%20never%20sitting%20still.>

Which of the following can be found as pollutants in the drinking water in some parts of India?

1. Arsenic
2. Sorbitol
3. Fluoride
4. Formaldehyde
5. Uranium

Select the correct answer using the codes given below.

- (a) 1 and 3 only
- (b) 2, 4 and 5 only
- (c) 1, 3 and 5 only
- (d) 1, 2, 3, 4 and 5

2013

Biological Oxygen Demand (BOD) is a standard criterion for

- (a) Measuring oxygen levels in blood
- (b) Computing oxygen levels in forest ecosystems
- (c) Pollution assay in aquatic ecosystems
- (d) Assessing oxygen levels in high altitude regions

2017

Radioactive Pollution

- Result of release of radioactive substances into the environment during
 - nuclear explosions, testing of nuclear weapons, nuclear weapon production and decommissioning,
 - mining of radioactive ores
 - handling and disposal of radioactive waste, and
 - accidents at nuclear power plants.
- Non-ionizing and Ionizing radiation
- Short-term exposure to high levels of radiation can cause immediate illness or death
- long-term exposure to low levels of radiation may increase the risk of cancer and other diseases



Radioactive Pollution

- Steps:
 - properly store, transport, and dispose of radioactive materials.
 - avoiding contaminated areas
 - using protective gear when working with radioactive materials, and
 - following safety guidelines in medical procedures that use radiation.
 - Nuclear non-proliferation
- ways to dispose of radioactive waste, including:
 - Burial: Burying the waste in a deep, secure underground location
 - Encapsulation: Encapsulating the waste in a durable material, such as concrete, and storing it in a secure location.
 - Reprocessing: Reprocessing the waste to extract usable materials and reduce the volume of waste is another option.

Light Pollution

- excessive or inappropriate use of outdoor artificial light
- affects human health, animal health, wildlife behavior, and astronomical observations.
- There are several types of light pollution, including:
 - **Glare:** when the intensity of light is too high, causing discomfort or vision problems.
 - **Skyglow:** brightening of the night sky that occurs due to the scattering of artificial light in the atmosphere.
 - **Light trespass:** when artificial light spills over onto areas where it is not wanted or needed, such as into a neighbor's window.
 - **Clutter:** confusing or excessive grouping of light sources, which can be disorienting and visually confusing.



Light Pollution

- Nocturnal light interrupts sleep and confuses the **circadian rhythm**
- For example, production of the hormone **melatonin**
 - An increased amount of light at night lowers melatonin production, which results in sleep deprivation
- Affects animals such as migration patterns, wake-sleep habits, and habitat formation.
- several ways to reduce light pollution,
 - including using shielded lighting fixtures,
 - turning off unnecessary lights,
 - using energy-efficient bulbs.
 - responsible lighting practices.

Waste Management



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Solid Waste Management

- The total quantity of Solid waste generated in the country is 160,038.9 TPD
- 75- 80% of the municipal waste gets collected and out of this only 22-28 % is processed and treated and remaining is disposed of indiscriminately at dump yards.

The Solid Waste Management Rules, 2016:

- Under Environment Protection Act, 1986
- **Applicability:** Municipal areas, urban agglomerations, towns, areas under the control of Indian Railways, airports, airbase, Port and harbour, defence establishments, special economic zones, State and Central government organizations, places of pilgrims, religious & historical importance.
- The Waste Generators: • Every household • Event organizers • Street Vendors • RWAs & Market Associations • Gated Community having more than area 5000 sq.m. • Hotels & restaurants, etc.
- 3R: The source segregation of waste has been mandated to channelize the waste to wealth by recovery, reuse and recycle.



Solid Waste Management

- Responsibilities of Generators have been introduced to segregate waste in to three streams, Wet (Biodegradable), Dry (Plastic, Paper, metal, wood, etc.) and domestic hazardous wastes (diapers, napkins, empty containers of cleaning agents, mosquito repellents, etc.) and handover segregated wastes to authorized rag-pickers or waste collectors or local bodies.
- Integration of waste pickers/ rag pickers and waste dealers/ Kabadiwalas in the formal system
- No person should throw, burn, or bury the solid waste generated by him, on streets, open public spaces outside his premises, or in the drain, or water bodies.
- Generator will have to pay 'User Fee' to waste collector and for 'Spot Fine' for Littering and Non-segregation.
- The bio-degradable waste should be processed, treated and disposed of through composting or bio-methanation
- Non-recyclable waste having calorific value of 1500 cal/kg or more shall not be disposed of on landfills and shall only be utilized for generating energy
- Construction and demolition waste should be stored, separately disposed off, as per the Construction and Demolition Waste Management Rules, 2016
- Construction of landfill on the hill shall be avoided.

Waste to Energy

- Methods:
 - Incineration: Direct burning
 - Plasma Gasification: extreme thermal process using plasma which converts organic matter into a syngas
 - Pyrolysis,: involves application of heat with no added oxygen in order to generate oils and/or syngas
 - Bio methanation: organic material is microbiologically converted under anaerobic conditions to biogas.
- Benefits:
 - Net Greenhouse Gas Reducer: Methane is a greenhouse gas which is mostly emitted from decomposing waste in landfills.
 - Resource savings and recovery
 - Landfill usage and expansion greatly reduced
 - Transportation of waste long distances can be greatly reduced

Waste to Energy

- Challenges:
 - Low Calorific Waste: Municipal waste in India is often not segregated properly. It has a very high biodegradable (wet) waste with a high moisture content and low calorific value.
 - High Toxic Waste: Incinerators develop toxic ash or slag, containing heavy metals and gas pollutants
 - Expensive power
 - Lack of Finance for Urban Local Bodies
 - inadequate quantity of supply; non-payment of agreed fee and non-marketability of waste processed projects
 - Opposition from local people
- Way forward
 - Improved MSW collection system
 - Encourage Private Partnership
 - a provision for State Electricity Discoms to mandatorily purchase all power
 - Incineration is preferable to pyrolysis (which is unsuited for our municipal solid waste) and plasma technology (which is too costly). Composting and biogas are not sustainable since they generate by-products or residues in large quantities.

Plastic Waste Management

- India produces 3.5 million tonnes of plastic annually, only about 50% is recycled.
- The Plastic Waste Management Rules, 2016, mandate the generators of plastic waste
 - to take steps to minimize generation of plastic waste,
 - not to litter the plastic waste,
 - ensure segregated storage of waste at source and hand over segregated waste in accordance with rules.
- Responsibilities of CPCB, SPCB/PCC, Local bodies, gram Panchayat, waste generators, retailers and street vendors, manufacturer, Importers and producer, recyclers and waste processors

Plastic Waste Management

PLASTIC CATEGORIES

- Plastic Waste Management (Amendment) Rules, 2022
- 4 categories of plastic based on recyclability as per Plastic Waste Management Rules, 2016
- **Ban on Single use plastic:** Ear buds with plastic sticks, plastic sticks for balloons, plastic flags, candy sticks, ice-cream sticks, polystyrene [Thermocol] for decoration, plastic cutlery for food



Plastic Waste Management

- the thickness of plastic carry bags has been increased from fifty microns to 75 microns and to 120 microns
- Extended Producer Responsibility Certificates:
 - sale and purchase of surplus extended producer responsibility certificates, a market mechanism for plastic waste management.
 - **Centralised Online Portal: single point data repository with respect to orders** and guidelines related to implementation of EPR
- Based on Polluter pays principle
- create an ecosystem for accelerated adoption and availability of alternatives across the country
- Challenges to implement the ban on single use plastics

Biomedical Waste Management

- about 619 tons/day of biomedical waste was generated during the year 2018-2019 by 3,22,425 numbers of Healthcare Facilities.
- Biomedical waste of about 74 tons/day might get disposed off through deep burials located at isolated places.
- Impact:
 - Infection: Biomedical waste can contain pathogens such as bacteria, viruses, and fungi that can cause serious infections if not properly handled.
 - Chemical hazards: Some biomedical waste may contain chemicals that can be harmful to humans and the environment if not disposed of properly.
 - Physical hazards: Sharps such as needles, scalpels, and broken glass can pose physical hazards if not properly contained and disposed of.
 - Environmental pollution: Improper disposal of biomedical waste can lead to pollution of soil and water, which can have negative impacts on the environment and public health.

Biomedical Waste Management

The Biomedical Waste Management Rules, 2016:

- Applicability to all generators of biomedical waste, including hospitals, clinics, nursing homes, laboratories, and research institutions.
- They outline the duties and responsibilities of these generators in relation to the segregation, storage, transportation, and disposal of biomedical waste.
- Bio-medical waste has been classified into 4 categories instead of 10 to improve the segregation of waste at source.
- Operator of a common bio-medical waste treatment and disposal facility to ensure the timely collection of bio-medical waste.



Yellow

**Human/Animal anatomical waste
Soiled waste, Expired medicine
Chemical waste, Body fluid, Clinical waste**



Red

**Contaminated waste (Recyclable)
Plastic bags, Bottles
Pipes, Container, Catheters**



White

**Scalpels, Blades, Needles
Syringes with fixed needle
Sharp metals, Needle tip cutter**



Blue

**Broken glassware, Cytotoxic waste
Metallic body implant
Contaminated glasses including medicine vials**

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Biomedical Waste Management

The Biomedical Waste Management Rules, 2016:

- No occupier shall establish on-site treatment and disposal facility, if a service of common bio-medical waste treatment facility is available at a distance of seventy-five kilometer.
- The rules require generators to separate biomedical waste into different categories based on the type of waste, such as infectious waste, pathological waste, and sharps.
- Pre-treatment of the laboratory waste, microbiological waste, blood samples and blood bags.
- They also prescribe specific requirements for the storage, transportation, and disposal of different categories of biomedical waste.
- The rules establish the Central Pollution Control Board and the State Pollution Control Boards as the implementing agencies for these rules.
- They also prescribe penalties for non-compliance, including fines and imprisonment.

Electronic Waste Management

- term used to describe old, end-of-life, or discarded electronic devices.
- According to the Global E-Waste Monitor 2017, India generates about **2 million tonnes (MT) of e-waste annually** and ranks 3rd among e-waste producing countries, after the China and US.
- E-waste can contain lead, polychlorinated biphenyls (PCBs), polybrominated biphenyls (PBBs), mercury, polybrominated diphenyl ethers (PBDEs), brominated flame retardants (BFRs), and valuable substances such as iron, steel, copper, aluminium, gold, silver, platinum, palladium, and plastics.

Electronic Waste Management

COMPONENTS

- Printed circuit boards
- Cathode ray tubes (CRTs)
- Switches & flat screen monitors
- Computer batteries
- Capacitors and transformers
- Printed circuit boards, plastic casings cable
- Cable insulation/coating

CONSTITUENTS

- Lead & cadmium
- Lead oxide & Cadmium
- Mercury
- Cadmium
- Poly Chlorinated Bi-phenyls (PCB)
- Brominated Flame Retardant
- Poly Vinyl Chloride (PVC)

Electronic Waste Management

E Waste Management Rules, 2016

- Producers of electronic products have a responsibility to take back their end-of-life products and ensure their safe disposal.
 - Extended Producer Responsibility
- Collection centers have been set up across the country to facilitate the collection and transportation of e-waste.
- E-waste recyclers must be registered and authorized by the Central Pollution Control Board (CPCB) in order to operate in India.

Electronic Waste Management

E Waste Management Rules, 2016

- E-waste recyclers must use environmentally sound techniques for the treatment, recycling, and disposal of e-waste.
- The rules also specify penalties for non-compliance with these regulations.
- Producer Responsibility Organizations (PROs) shall apply to the Central Pollution Control board (CPCB) for registration to undertake activities prescribed in the Rules.
- Companies will have to register on an online portal and specify their annual production and e-waste collection targets

Bioremediation

- Bioremediation is a natural and cost-effective way to clean up environmental pollution.
- it relies on the ability of certain microorganisms to break down and neutralize toxic substances.
- Can work on a wide range of pollutants, including oil spills, chemical waste, heavy metals, and contaminated soil.
- in situ or ex situ
- Condition for Bioremediation
 - such as the right temperature, pH, and nutrient levels.
- It is not always successful, as it can be slowed or stopped by factors such as the toxicity of the pollutants, the availability of nutrients, and the presence of other environmental stresses.
- Phytoremediation process which helps to absorb the Heavy metals in the soil by using plants and trees to remediate the soil.

International Conventions

- Basel Convention, 1992:
 - control of Transboundary Movements of Hazardous Wastes and their Disposal
 - applies Prior Consent Approval procedure to regulate the transboundary movement
 - Radioactive Wastes & Wastes derived from normal operations of the ships are excluded from the list of hazardous wastes
 - India is a member.

International Conventions

- Stockholm Convention, 2001:
 - Persistent Organic Pollutants
 - Known for toxicity and biomagnification, certain cancers, birth defects, dysfunctional immune and reproductive systems,
 - Original: 12 POPs (dirty dozens, mostly pesticides), many added later
 - convention aims to reduce or eliminate the use of POPs listed in Annex A through the active measures of the member states.
 - India is a member.

International Conventions

- Rotterdam Convention, 1998:
 - Entered in force in 2004
 - to ensure shared responsibilities and cooperative efforts while trading certain hazardous chemicals internationally.
 - To exchange information about the characteristics of the chemicals that the parties to the convention trade
- chemicals listed in Annex III include pesticides and industrial chemicals that have been banned or severely restricted for health or environmental reasons by two or more Parties
- two important mechanisms:
 - PIC Procedure
 - Information Exchange
- India is a member.

International Conventions

- Minamata Convention, 2013
 - an international environmental treaty that aims to protect human health and the environment from the harmful effects of mercury and its compounds.
 - include a ban on new mercury mines, the phase-out of existing ones, the phase-out and phase-down of mercury use in a number of products and processes
 - Minamata disease
 - India is a member.

International Conventions

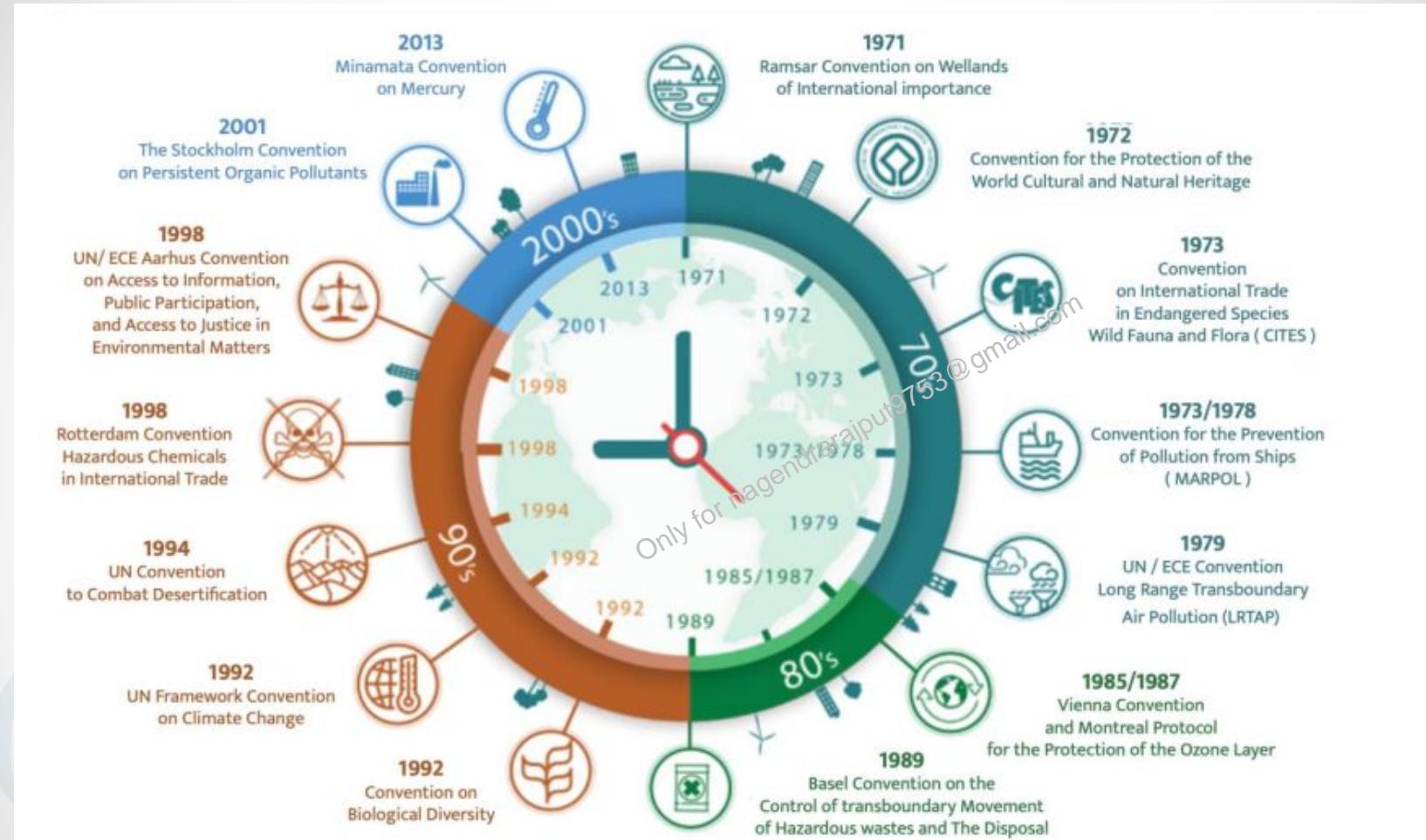
- MARPOL Convention, 1973
 - Entered in force in 1983
 - Under International Maritime Organization
 - aimed at preventing and minimizing pollution from ships - both accidental pollution and that from routine operations - and currently includes six technical Annexes.
 - India is a signatory.

International Conventions

- Convention on Long range Transboundary Air Pollution
- implemented by the European Monitoring and Evaluation Programme (EMEP), directed by the United Nations Economic Commission for Europe (UNECE).

8 Protocols:

- **Aarhus Protocol** on Heavy Metals
- **Gothenburg Protocol** to Abate Acidification, Eutrophication and Ground-level Ozone
- **Aarhus Protocol** on Persistent Organic Pollutants (POPs)
- **Oslo Protocol** on Further Reduction of Sulphur Emissions
- **Geneva Protocol** concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes
- **Sofia Protocol** concerning the Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes
- **Helsinki Protocol** on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30 per cent
- **Geneva Protocol** on Long-term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe



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Mains Questions

- Discuss in detail the photochemical smog emphasizing its formation, effects and mitigation. Explain the 1999 Gothenburg Protocol. (Answer in 150 words) 10. - 2022
- Q. Describe the key points of the revised Global Air Quality Guidelines (AQGs) recently released by the World Health Organisation (WHO). How are these different from its last update in 2005? What changes in India's National Clean Air Programme are required to achieve revised standards? (2021)
- What are the key features of the National Clean Air Programme (NCAP) initiated by the government of India. (Answer in 250 words) 15 2020
- Coastal sand mining, whether legal or illegal, poses one of the biggest threats to our environment. Analyse the impact of sand mining along the Indian coasts, citing specific examples. (Answer in 200 words) 12.5 2017

2013

Due to improper/indiscriminate disposal of old and used computers or their parts, which of the following are released into the environment as e-waste?

1. Beryllium
2. Cadmium
3. Chromium
4. Heptachlor
5. Mercury
6. Lead
7. Plutonium

Select the correct answer using the codes given below.

- (a) 1, 3, 4, 6 and 7 only
- (b) 1, 2, 3, 5 and 6 only
- (c) 2, 4, 5 and 7 only
- (d) 1, 2, 3, 4, 5, 6 and 7

Recently, "oilzapper" was in the news.
What is it ?

- (a) It is an eco-friendly technology for the remediation of oily sludge and oil spills
- (b) It is the latest technology developed for under sea oil exploration
- (c) It is a genetically engineered high biofuel yielding maize variety
- (d) It is the latest technology to control the accidentally caused flames from oil wells

2011

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Lead, ingested or inhaled, is a health hazard. After the addition of lead to petrol has been banned, what still are the sources of lead poisoning?

1. Smelting units
2. Pens and pencils
3. Paints
4. Hair oils and cosmetics

Select the correct answer using the codes given below :

- (a) 1, 2 and 3 only
- (b) 1 and 3 only
- (c) 2 and 4 only
- (d) 1, 2, 3 and 4

2012

Brominated flame retardants are used in many household products like mattresses and upholstery. Why is there some concern about their use?

1. They are highly resistant to degradation in the environment.
2. They are able to accumulate in humans and animals.

Select the correct answer using the code given below.

2014

- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 nor 2

2017

In the context of solving pollution problems, what is/are the advantage/advantages of bioremediation technique ?

1. It is a technique for cleaning up pollution by enhancing the same biodegradation process that occurs in nature.
2. Any contaminant with heavy metals such as cadmium and lead can be readily and completely treated by bioremediation using microorganisms.
3. Genetic engineering can be used to create microorganisms specifically designed for bioremediation.

Select the correct answer using the code given below :

- (a) 1 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

In the context of which one of the following are the terms 'pyrolysis and plasma gasification' mentioned?

- (a) Extraction of rare earth elements
- (b) Natural gas extraction technologies
- (c) Hydrogen fuel-based automobiles
- (d) Waste-to-energy technologies

2019

Why is there a great concern about the 'microbeads' that are released into environment?

- (a) They are considered harmful to marine ecosystems.
- (b) They are considered to cause skin cancer in children.
- (c) They are small enough to be absorbed by crop plants in irrigated fields.
- (d) They are often found to be used as food adulterants.

2019

In India, the use of carbofuran, methyl parathion, phorate and triazophos is viewed with apprehension. These chemicals are used as

- (a) pesticides in agriculture
- (b) preservatives in processed foods
- (c) fruit-ripening agents
- (d) moisturising agents in cosmetics

As per the Solid Waste Management Rules, 2016 in India, which one of the following statements is correct?

- (a) Waste generator has to segregate waste into five categories.
- (b) The Rules are applicable to notified urban local bodies, notified towns and all industrial townships only.
- (c) The Rules provide for exact and elaborate criteria for the identification of sites for landfills and waste processing facilities.
- (d) It is mandatory on the part of waste generator that the waste generated in one district cannot be moved to another district.

2019

In India, 'extended producer responsibility' was introduced as an important feature in which of the following?

- (a) The Bio-medical Waste (Management and Handling) Rules, 1998
- (b) The Recycled Plastic (Manufacturing and Usage) Rules, 1999
- (c) The e-Waste (Management and Handling) Rules, 2011
- (d) The Food Safety and Standard Regulations, 2011

2019

Steel slag can be the material for which of the following ?

1. Construction of base road
2. Improvement of agricultural soil
3. Production of cement

Select the correct answer using the code given below :

- (a) 1 and 2 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

2020

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In rural road construction, the use of which of the following is preferred for ensuring environmental sustainability or to reduce carbon footprint ?

1. Copper slag
2. Cold mix asphalt technology
3. Geotextiles
4. Hot mix asphalt technology
5. Portland cement

Select the correct answer using the code given below :

- (a) 1, 2 and 3 only
- (b) 2, 3 and 4 only
- (c) 4 and 5 only
- (d) 1 and 5 only

2020

Why is there a concern about copper smelting plants?

1. They may release lethal quantities of carbon monoxide into environment.
2. The copper slag can cause the leaching of some heavy metals into environment.
3. They may release sulphur dioxide as a pollutant.

2021

Select the correct answer using the code given below.

- (a) 1 and 2 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

With reference to furnace oil, consider the following statements :

1. It is a product of oil refineries.
2. Some industries use it to generate power.
3. Its use causes sulphur emissions into environment.

Which of the statements given above are correct?

2021

- (a) 1 and 2 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

Magnetite particles, suspected to cause neurodegenerative problems, are generated as environmental pollutants from which of the following?

1. Brakes of motor vehicles
2. Engines of motor vehicles
3. Microwave stoves within homes
4. Power plants
5. Telephone lines

Select the correct answer using the code given below.

- (a) 1, 2, 3 and 5 only
- (b) 1, 2 and 4 only
- (c) 3, 4 and 5 only
- (d) 1, 2, 3, 4 and 5

2021

2022

With reference to polyethylene terephthalate, the use of which is so widespread in our daily lives, consider the following statements :

1. Its fibres can be blended with wool and cotton fibres to reinforce their properties.
2. Containers made of it can be used to store any alcoholic beverage.
3. Bottles made of it can be recycled into other products.
4. Articles made of it can be easily disposed of by incineration without causing greenhouse gas emissions.

Which of the statements given above are correct ?

- (a) 1 and 3
- (b) 2 and 4
- (c) 1 and 4
- (d) 2 and 3

2022

Which one of the following best describes the term “greenwashing”?

- (a) Conveying a false impression that a company's products are eco-friendly and environmentally sound
- (b) Non-inclusion of ecological/environmental costs in the Annual Financial Statements of a country
- (c) Ignoring the disastrous ecological consequences while undertaking infrastructure development
- (d) Making mandatory provisions for environmental costs in a government project/programme

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Consider the following statements regarding mercury pollution :

1. Gold mining activity is a source of mercury pollution in the world.
2. Coal-based thermal power plants cause mercury pollution.
3. There is no known safe level of exposure to mercury.

How many of the above statements are correct?

- (a) Only one
- (b) Only two
- (c) All three
- (d) None

2023