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Unit I Introduction of global warming

Introduction - the gas law - ideal gas equation- the mole concept- sample calculations- ppm - sulphur pollutants-oxides of nitrogen - particulate - Green House Gases.

Introduction:

The earth's atmosphere has always acted like a greenhouse to capture the sun's heat, ensuring that the earth has enjoyed temperatures that permitted the emergence of life forms as we know them, including humans. Without our atmospheric greenhouse the earth would be very cold. The best evidence of this may come from a terrible cooling event that took place some 1,500 years ago. Two massive volcanic eruptions, one year after another placed so much black dust into the upper atmosphere that little sunlight could penetrate. Temperatures plummeted. Crops failed. People died of starvation and the Black Death started its march. As the dust slowly fell to earth, the sun was again able to warn the world and life returned to normal.

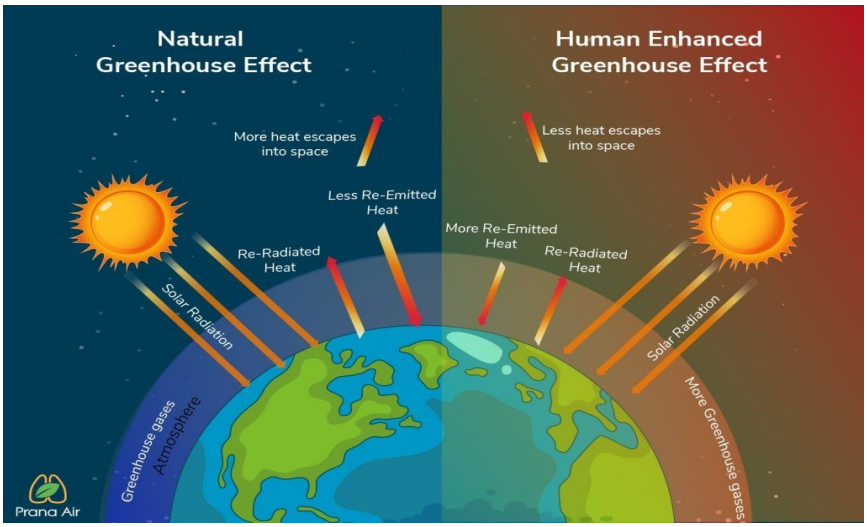
Today, we have the opposite problem. Today, the problem is not that too little sun warmth is reaching the earth, but that too much is being trapped in our atmosphere. So much heat is being kept inside greenhouse earth that the temperature of the earth is going up faster than at any previous time in history.

Global Warming is the slow increase in the average temperature of the earth's atmosphere because an increased amount of the energy (heat) striking the earth from the sun is being trapped in the atmosphere and not radiated out into space.

The main causes of global warming are anthropogenic, that is they are induced by human activities. Human activities generate greenhouse gases resulting in greenhouse effect and global warming. It impacts the ecology and threatens the very existence of life on earth in several ways.

Greenhouse effect, a warming of Earth's surface and troposphere (the lowest layer of the atmosphere) caused by the presence of water vapor, carbon dioxide, methane, and certain other gases in the air. Of those gases, known as greenhouse gases, water vapor has the largest effect.

The atmosphere allows most of the visible light from the Sun to pass through and reach Earth's surface. As Earth's surface is heated by sunlight, it radiates part of this energy back toward space as infrared radiation. This radiation, unlike visible light, tends to be absorbed by the greenhouse gases in the atmosphere, raising its temperature. The heated atmosphere in turn radiates infrared radiation back toward Earth's surface. (Despite its name, the greenhouse effect is different from the warming in a greenhouse, where panes of glass transmit visible sunlight but hold heat inside the building by trapping warmed air.)



Without the heating caused by the greenhouse effect, Earth's average surface temperature would be only about −18 °C (0 °F). On Venus the very high concentration of carbon dioxide in the atmosphere causes an extreme greenhouse effect resulting in surface temperatures as high as 450 °C (840 °F).

The 10 main greenhouse gases are:

- Water vapour (H_2O)
- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Ozone (O_3)
- Chlorofluorocarbons (CFCs and HCFCs)
- Hydro fluorocarbons (HFCs)
- Per fluorocarbons (CF. $_4$, C. $_2$F. $_6$, etc.), SF. $_6$, and NF.

Causes of Green house effects / Factors responsible for Global warming:

1) The extensive use of fossil fuel is the foremost cause of global warming

    - Thermal power stations based on fossil fuels, mainly coal and mineral oil emitting huge amount of CO_2
    - Burning of fossil fuels.
    - Fossil fuel combustion by Automobiles

2) Pollution generation by numerous factories and industrial chimney wastes
3) CFC's (Chlorofluorocarbons) emission by human activities
4) Deforestation
5) Over exploitation of resources
6) Urbanization
7) Chemical fertilizers and pesticides used in agricultural activities contribute to the greenhouse effect and global warming.

Effects of Greenhouse effect:

❖ **Global warming and climate change:**

Global warming refers to an increase in the Earth's average temperature.

Climate is the average weather conditions over time. **Climate change:** Is the long-term changes in climate, including average temperature and precipitation. It recognizes that, although the average surface temperature may increase, the regional or local temperature may decrease or remain constant.

The global climate is the connected system of sun, earth and oceans, wind, rain and snow, forests, deserts and savannas, and everything people do, too. The global climate is more than the average of the Climates of specific places.

A description of the global climate includes how, for example, the rising temperature of the Pacific feeds typhoons which blow harder, drop more rain and cause more damage, but also shifts global ocean currents that melt Antarctica ice which slowly makes sea level rise until New York will be under water. It is this systemic connectedness that makes global climate change so important and so complicated.

What causes Earth's climate to change?

Natural processes: Volcanoes, Tectonic plate movement, Changes in the sun, Shifts in Earth's orbit

Human activities: any activity that releases "greenhouse gases" into the atmosphere. Some of them are: Rapid industrialization, Energy Use, Agricultural Practices, Deforestation, Consumer practices, Livestock, Transport, Resource extraction and Pollution.

Difference between Global Warming and Climate Change:

Global Warming	Climate Change
A gradual increase in the overall temperature of the earth's atmosphere generally attributed to the greenhouse effect caused by increased levels of carbon dioxide, CFCs, and other pollutants	A change in global or regional climate patterns, in particular, a change apparent from the mid to late 20_{th} century onwards and attributed largely to the increased levels of atmospheric Carbon dioxide produced by the use of fossil fuels
It Occurs due to the human expansion of greenhouse effect	It Emerges due to global Warming
It Increase of the earth's average temperature	It Includes the increasing temperature, changes in the wind and precipitation, lengthening of seasons, increased strength and frequency of extreme Weather
It is a Worldwide Phenomenon	It is Either global or regional

- **Rise of sea level:**

Global warming is causing global mean sea level to rise in two ways. First, glaciers and ice sheets worldwide are melting and adding water to the ocean. Second, the volume of the ocean is expanding as the water warms.

- **Worsening health effects:**

The health effects of these disruptions include increased respiratory and cardiovascular disease, injuries and premature deaths related to extreme weather events, changes in the prevalence and geographical distribution of food- and water-borne illnesses and other infectious diseases, and threats to mental health.

- **Disruption of the water cycle:**

Science has shown that climate change touches every corner of our planet's ecosystem, and the water cycle is no exception. Because the processes involved are highly dependent on temperature, changes in one have consequences on the other. Specifically, as global temperatures have steadily increased at their fastest rates in millions of years, it's directly affected things like water vapor concentrations, clouds, precipitation patterns, and stream flow patterns, which are all related to the water cycle.

So how does climate change impact the water cycle? We've created an infographic below that illustrates what's going on, but we'll describe it here too. Put simply, water evaporates from the land and sea, which eventually returns to Earth as rain and snow. Climate change intensifies this cycle because as air temperatures increase, more water evaporates into the air. Warmer air can hold more water vapor, which can lead to more intense rainstorms, causing major problems like extreme flooding in coastal communities around the world.

But it doesn't end there. At the same time that some areas are experiencing stronger storms, others are experiencing more dry air and even drought. Like we mentioned above, as temperatures rise, evaporation increases and soils dry out. Then when rain does come, much of the water runs off the hard ground into rivers and streams, and the soil remains dry. The result, Still more evaporation from the soil and an increased risk of drought.

- **Challenges to agriculture and the food supply:**

Agriculture is extremely vulnerable to climate change. Higher temperatures eventually reduce yields of desirable crops while encouraging weed and pest proliferation. Changes in precipitation patterns increase the likelihood of short-run crop failures and long-run production declines. This leads to disrupt food availability, reduce access to food, and affect food quality.

- **Effect on oceanic climate**

As greenhouse gases trap more energy from the sun, the oceans are absorbing more heat, resulting in an increase in sea surface temperatures and rising sea level. Changes in ocean temperatures and currents brought about by climate change will lead to alterations in climate patterns around the world.

- **Increase in heat Waves**

Unusually hot days and multi-day heat waves are a natural part of day-to-day variation in weather. As the Earth's climate warms, however, hotter-than-usual days and nights are becoming more common (see the High and Low Temperatures indicator) and heat waves are expected to become more frequent and intense.

- **Social tensions**

As the climate continues to change, millions of poor people face greater challenges in terms of extreme events, health effects, food security, livelihood security, migration, water security, cultural identity, and other related risks. Climate change is deeply intertwined with global patterns of inequality.

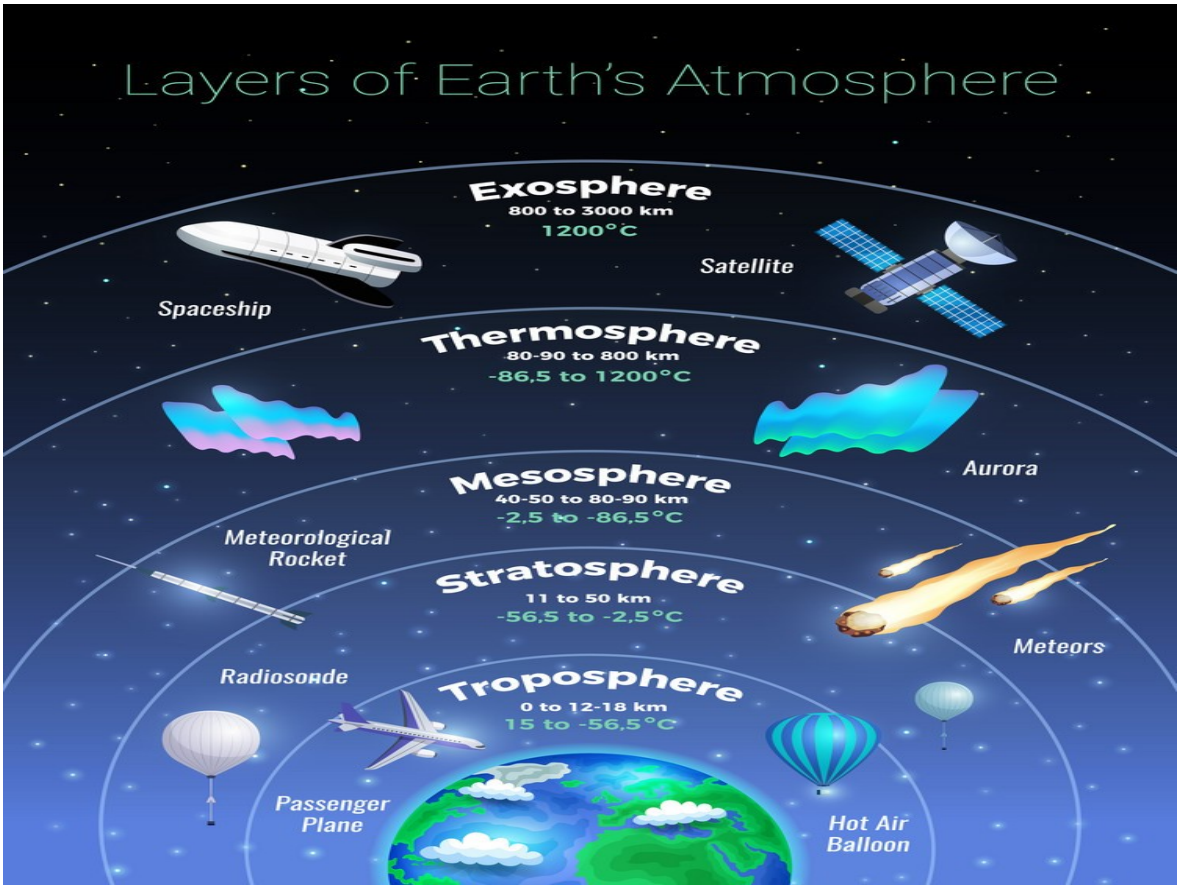
❖ **Migration**

Climate migrants are people who leave their homes because of climate stressors. Climate stressors, such as changing rainfall, heavy flooding, and sea level rise, put pressure on people to leave their homes and livelihoods behind. It makes their homes uninhabitable.

❖ **Change in land use**

Land use change is an important driver of climate change, a changing climate can lead to changes in land use and land cover. For example, farmers might shift from their customary crops to crops that will have higher economic return under changing climatic conditions.

❖ **Effect on the ozone layer**



Ozone Layer:

The ozone layer is found in the lower portion of the earth's atmosphere. It has the potential to absorb around 97-99% of the harmful ultraviolet radiations coming from the sun that can damage life on earth. If the ozone layer was absent, millions of people would develop skin diseases and may have weakened immune systems.

Ozone Layer Depletion:

"Ozone layer depletion is the gradual thinning of the earth's ozone layer in the upper atmosphere caused due to the release of chemical compounds containing gaseous bromine or chlorine from industries or other human activities."

Causes of Ozone Layer Depletion:

The ozone layer depletion is a major concern and is associated with a number of factors. The main causes responsible for the depletion of the ozone layer are listed below:

Chlorofluorocarbons

Chlorofluorocarbons or CFCs are the main cause of ozone layer depletion. These are released by solvents, spray aerosols, refrigerators, air-conditioners, etc. The molecules of chlorofluorocarbons in the stratosphere are broken down by the ultraviolet radiations and release chlorine atoms. These atoms react with ozone and destroy it.

Unregulated Rocket Launches

Researchers say that the unregulated launching of rockets result in much more depletion of ozone layer than the CFCs do. If not controlled, this might result in a huge loss of the ozone layer by the year 2050.

Nitrogenous Compounds

The nitrogenous compounds such as NO_2, NO, N_2O are highly responsible for the depletion of the ozone layer.

Natural Causes

The ozone layer has been found to be depleted by certain natural processes such as Sun-spots and stratospheric winds. But it does not cause more than 1-2% of the ozone layer depletion. The volcanic eruptions are also responsible for the depletion of the ozone layer.

Ozone Depleting Substances (ODS)

"Ozone depleting substances are the substances such as chlorofluorocarbons, halons, carbon tetrachloride, hydrofluorocarbons, etc. that are responsible for the depletion of ozone layer."

Following is the list of some main ozone-depleting substances and the sources from where they are released:

- ✓ Chlorofluorocarbons (CFCs) Refrigerators, air-conditioners, solvents, dry-cleaning agents, etc.
- ✓ Halons Fire-extinguishers
- ✓ Carbon tetrachloride Fire extinguishers, solvents
- ✓ Methyl chloroform Adhesives, aerosols
- ✓ Hydrofluorocarbons fire extinguishers, air-conditioners, solvents

Effects of Ozone Layer Depletion

The depletion of the ozone layer has harmful effects on the environment. Let us see the major effects of ozone layer depletion on man and environment.

Effects on Human Health: The humans will be directly exposed to the harmful ultraviolet radiations of the sun due to the depletion of the ozone layer. This might result in serious health issues among humans, such as skin diseases, cancer, sunburns, cataract, quick ageing and weak immune system.

Effects on Animals: Direct exposure to ultraviolet radiations leads to skin and eye cancer in animals.

Effects on the Environment: Strong ultraviolet rays may lead to minimal growth, flowering and photosynthesis in plants. The forests also have to bear the harmful effects of the ultraviolet rays.

Effects on Marine Life: Planktons are greatly affected by the exposure to harmful ultraviolet rays. These are higher in the aquatic food chain. If the planktons are destroyed, the organisms present in the food chain are also affected.

Solutions to Ozone Layer Depletion: The depletion of the ozone layer is a serious issue and various programmes have been launched by the government of various countries to prevent it. However, steps should be taken at the individual level as well to prevent the depletion of the ozone layer.

Following are some points that would help in preventing this problem at a global level:

Avoid Using ODS: Reduce the use of ozone depleting substances. E.g. avoid the use of CFCs in refrigerators and air conditioners, replacing the halon based fire extinguishers, etc.

Minimize the Use of Vehicles: The vehicles emit a large amount of greenhouse gases that lead to global warming as well as ozone depletion. Therefore, the use of vehicles should be minimised as much as possible.

Use Eco-friendly Cleaning Products: Most of the cleaning products have chlorine and bromine releasing chemicals that find a way into the atmosphere and affect the ozone layer. These should be substituted with natural products to protect the environment.

Use of Nitrous Oxide should be prohibited: The government should take actions and prohibit the use of harmful nitrous oxide that is adversely affecting the ozone layer. People should be made aware of the harmful effects of nitrous oxide and the products emitting the gas so that its use is minimized at the individual level as well.

Control of Greenhouse Effect:

- Alternate sources of energy are to be used
- Advanced and efficient technologies for reducing emissions from fossil fuels.
- Afforestation and reforestation on a large scale
- Water logging should be avoided
- Reduction of the use of CFC
- Carbon market
- Use renewable energy sources and reduce Non renewable energy sources
- Use CNG instead of petrol and diesel.
- Use CNG instead of burning coal, wood and fossil fuels.
- Start cycling or walking to short distances
- Use carpool or common transport system.

Renewable Energy Sources and Non renewable energy sources:

Resources are characterized as renewable or nonrenewable; a renewable resource can replenish itself at the rate it is used, while a nonrenewable resource has a limited supply. Renewable resources include timber, wind, and solar while nonrenewable resources include coal and natural gas

Difference between Renewable Energy Sources and Non renewable energy sources

Renewable Energy Sources	Non renewable energy sources
It can be replaced process in a short amount of time or can be recycled	These are natural resource that either cannot be replaced or may take millions of years to replace by natural process like coal and oil.
It can be reused or recycled and used multiple times	It cannot be reused or recycled
Some of the example is: wind energy, solar power, hydroelectricity, geo thermal.	Some of the examples are:Petrol,coal,Nature gas, nuclear energy, fossil fuel
No harm done to the environment because of its use	Huge harm done due to the environment because of the harmful emissions

Oxides of Sulphur:

- Oxides of sulphur are produced when sulphur containing fossil fuel is burnt.
- Most common species, sulphur, sulphur dioxide, is a gas that is poisonous to both animals and plants.
- Sulphur dioxide causes irritation to the eyes, resulting in tears and redness.
- High concentration of SO_2 leads to stiffness of flower buds which eventually fall off from plants.

Oxides of Nitrogen:

- At high altitudes when lightning strikes, Nitrogen and Oxygen Combine to form Oxides of nitrogen
- NO is oxidised to nitrate ion,NO_3- which is washed into soil, Where it serves as a fertilizer.
- In an automobile engine,(at high temperature) when fossil fuel is burnt,dinitrogen and hydrogen combine to yield significant quantities of nitric oxide (NO) and nitrogen dioxide(NO_2)
- The irritant red haz in the traffic and congested places is due to oxides of nitrogen.
- Higher concentrations of NO_2 damage the leaves of plants and retard the rate of photosynthesis.
- Nitrogen dioxide is a lung irritant that can lead to an acute respiratory disease in children.It is toxic to living tissues also Nitrogen dioxide is also harmful.

GAS LAW:

Introduction: What are the Gas Laws?

The gas laws are a group of laws that govern the behaviour of gases by providing relationships between the following:

- The volume occupied by a gas.
- The pressure exerted by a gas on the walls of its container.
- The absolute temperature of the gas.
- The amount of gaseous substance (or) the number of moles of gas.

The gas laws were developed towards the end of the 18^{th} century by numerous scientists (after whom, the individual laws are named). The five gas laws are:

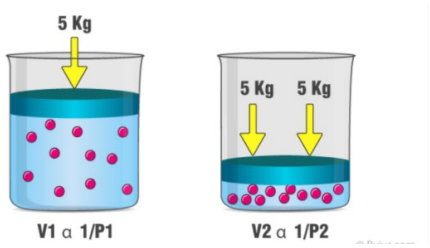
- ✓ Boyle's Law, which provides a relationship between the pressure and the volume of a gas.

- ✓ Charles's Law, which provides a relationship between the volume occupied by a gas and the absolute temperature.
- ✓ Gay-Lussac's Law, which provides a relationship between the pressure exerted by a gas on the walls of its container and the absolute temperature associated with the gas.
- ✓ Avogadro's Law, which provides a relationship between the volume occupied by a gas and the amount of gaseous substance.
- ✓ The Combined Gas Law (or the Ideal Gas Law), which can be obtained by combining the four laws listed above.

Under standard conditions, all gasses exhibit similar behaviour. The variations in their behaviours arise when the physical parameters associated with the gas (such as temperature, pressure, and volume) are altered. The gas laws basically describe the behaviour of gases and have been named after the scientists who discovered them.

Boyle's Law

Boyle's law gives the relationship between the pressure of a gas and the volume of the gas at a constant temperature. Basically, the volume of a gas is inversely proportional to the pressure of a gas at a constant temperature.



Boyle's law equation is written as:

$V \propto 1/P$

Or

$P \propto 1/V$

Or

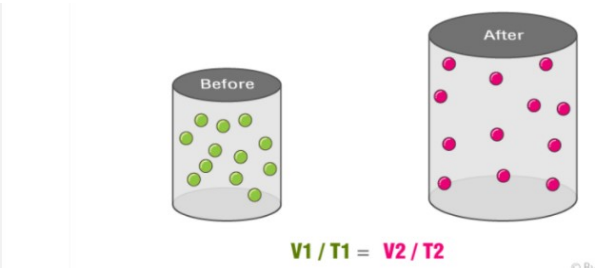
$PV = k_1$

Where V is the volume of the gas, P is the pressure of the gas and K_1 is the constant. Boyle's Law can be used to determine the current pressure or volume of gas and can be represented also as;

$P_1V_1 = P_2V_2$

Charle's Law

Charle's law states that at constant pressure, the volume of a gas is directly proportional to the temperature (in Kelvin) in a closed system. Basically, this law describes the relationship between the temperature and volume of the gas.



Mathematically, Charle's law can be expressed as;

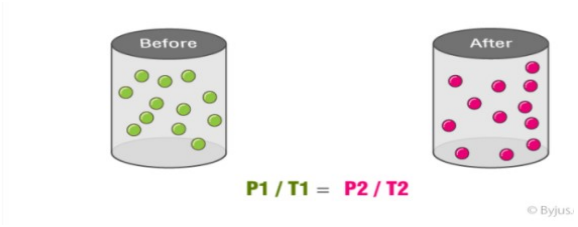
$V \propto T$

Where, V = volume of gas, T = temperature of the gas in Kelvin. Another form of this equation can be written as;

$V_1 / T_1 = V_2 / T_2$

Gay-Lussac Law

Gay-Lussac law gives the relationship between temperature and pressure at constant volume. The law states that at a constant volume, the pressure of the gas is directly proportional to the temperature for a given gas.



If you heat up a gas, the molecules will be given more energy, they move faster. If you cool d own the molecules, they slow down and the pressure decreases. The change in temperature and pressure can be calculated using Gay-Lussac law and it is mathematically represented as;

$P \propto T$

Or

$P / T = k_1$

or

$P_1 / T_1 = P_2 / T_2$

Where P is the pressure of the gas and T is the temperature of the gas in Kelvin.

Avogadro's Law

Avogadro's law states that if the gas is an ideal gas, the same number of molecules exists in the system. The law also states that if the volume of gases is equal it means that the number of the molecule will be the same as the ideal gas only when it has equal volume. This above statement can be mathematically expressed as;

$V / n = constant$

Or

$V_1 / n_1 = V_2 / n_2$

Where V is the volume of an ideal gas and n in the above equation represent the number of gas molecules.

Combined Gas Law

The combined gas law is also known as a general gas equation is obtained by combining three gas laws which include Charles's law, Boyle's Law and Gay-Lussac law. The law shows the relationship between temperature, volume and pressure for a fixed quantity of gas.

The general equation of combined gas law is given as;

$PV / T = k$

If we want to compare the same gas in different cases, the law can be represented as;

$P_1V_1 / T_1 = P_2V_2 / T_2$

Also Read: Kinetic Theory of Gas

Ideal Gas Law

Much like the combined gas law, the ideal gas law is also an amalgamation of four different gas laws. Here, Avogadro's law is added and the combined gas law is converted into the ideal gas law. This law relates four different variables which are pressure, volume, no of moles or molecules and temperature. Basically, the ideal gas law gives the relationship between these above four different variables.

Mathematically Ideal gas law is expressed as;

PV=nRT

Where,

V = volume of gas.

T = temperature of the gas.

P = pressure of the gas.

R = universal gas constant.

n denotes the number of moles.

We can also use an equivalent equation given below.

PV = kNT

Where, k = Boltzmann constant and N = number of gas molecules.

Ideal Gas

Ideal gases are also known as a perfect gas. It establishes a relationship among the four different gas variables such as pressure (P), Volume(V), Temperature(T) and amount of gas (n).

Ideal Gas Properties and Characteristics

- The motion of ideal gas in a straight line constant and random.
- The gas occupies a very small space because the particle in the gas is minimal.
- There is no force present between the particle of the gas. Particles only collide elastically with the walls of the container and with each other.
- The average kinetic energy of the gas-particle is directly proportional to the absolute temperature.
- The gases are made up of many the same particles (atoms or molecules) which are perfectly hard spheres and also very small.
- The actual volume of the gas molecule is considered negligible as compared to the space between them and because of this reason they are considered as the point masses.

Gas Law Formula Table

The following table consists of all the formulas of Gas Law.

Gas Law	Formula	Description
Charles's Law	V1/T1=V2/T2	At constant P, as the volume increases the temperature also increases.
Boyle's Law	P1V1=P2V2	At constant T, if pressure increases then volume decreases.
Gay- Lussac Law	P1/T1=P2/T2	At constant V as pressure increases the temperature also increases.
Avogadro's Law	V / n = constant	When the amount of gas increases, the volume of the gas also increases.
Ideal Gas Law	PV=nRT	

Application Of Gas-law

During summer when the temperature is high and pressure is also high, a tire is at risk of bursting because it is inflated with air. Or when you start climbing a mountain you feel some problems related to inhaling? Why does it happen?

When the physical condition is changing with changing in the environment the behaviour of gases particle also deviates from their normal behaviour. These changes in gas behaviour can be studied by studying various laws known as gas law.

The gas laws have been around for quite some time now, and they significantly assist scientists in finding amounts, pressure, volume, and temperature when coming to matters of gas.

Besides, the gas law along with modern forms are used in many practical applications that concern a gas. For example, respiratory gas measurement of tidal volume and vital capacity etc are done at ambient temperature while these exchanges actually take place in the body at 37-degree Celcius. The law is also used often in thermodynamics as well as in fluid dynamics. It can be used in the weather forecast systems.

MOLE CONCEPT:

A mole is **a unit of measurement used to measure the amount of any fundamental entity (atoms, molecules, ions) present in the substance**. A mole is very much similar to the concept of weight, as both help in understanding the amount of a substance present.

Definitions of Terms Related to Mole:

- **Molar Mass:** The mass of one mole of a substance is defined as the molar mass of a substance. This is different from the molecular mass of a substance. The SI unit of molar mass is **kilograms/mole.**
- **Molecular Mass:** It is the mass of a molecule that is a **summation of masses** of all individual participating elements.
- **Atomic Mass Unit (amu):** The atomic mass unit is the ratio of grams of a substance to Avogadro's number. It is important to note that the molar mass of a substance (1 mol) will be equal to its atomic mass unit

Avogadro's number:

Avogadro's number tells us **the number of particles in 1 mole (or mol) of a substance**. These particles could be electrons or molecules or atoms. The value of Avogadro's number is approximately 6.022140857×10^{23} mol^{-1}

Particulate matter:

"Particulate matter," also known as particle pollution or PM, is **a complex mixture of extremely small particles and liquid droplets**. Particle pollution is made up of a number of components, including acids (such as nitrates and sulphates), organic chemicals, metals, and soil or dust particles

Particle size distribution **affects the strength or reactivity of solids participating in chemical reactions**. As a result, hydraulic and combustion fluids, cement, ink toner, cosmetics, and many pharmaceutical products could malfunction if particle size distribution is off.

FORMING PARTICULATE MATTER:

The size of suspended particles in the atmosphere varies over four orders of magnitude, from a few nanometers to tens of micrometers. The largest particles, called the coarse fraction (or mode), are mechanically produced by the break-up of larger solid particles.

Traffic produces road dust and air turbulence that can stir up road dust. Near coasts, evaporation of sea spray can produce large particles. Pollen grains, mould spores, and plant and insect parts are all in this larger size range.

The size of range of particulate matter is Industrial facilities, Power plants, vehicles, incinerators, dust and fires are the major source of particulate matter. The particle size ranges **between 2.5 mm ($PM_{2.5}$) and 10 mm (PM_{10})**.

The different sources of particulate matter are Natural sources of PM include sea salt, dust (airborne soil, also called crustal material), secondary sulphate, pollen, black carbon from wild fires, and volcanic ash.

Particulate matter 2.5 ($PM_{2.5}$), refers to **tiny particles or droplets in the air that are two and one half microns or less in width**. Like inches, meters and miles, a micron is a unit of measurement for distance. There are about 25,000 microns in an inch.

PM10 is any particulate matter in the air with a diameter of 10 micrometers or less, including smoke, dust, soot, salts, acids, and metals. Particulate matter can also be formed indirectly when gases emitted from motor vehicles and industries undergo chemical reactions in the atmosphere.

Environmental impact:

- Important of visibility: fine particles reduce visibility.
- Damage to environment: particles can be carried over long distances by wind and settle on ground or water. They make lakes and streams acidic,deplete nutrients in soil and damage sensitive forests and farm crops.
- Aesthetic effects: Settling particles on statues and monuments can stain or damage stone and other materials.

Health risks of particulate matter:

Particulate matter poses a serious health risk because it can travel into the respiratory tract.PM2.5 is especially dangerous because it can peneterate deep into the lungs and sometimes even into the lungs and sometimes even into the bloodstream.

Health Effects:

- Decreased lung function
- Chronic bronchitis
- Increased respiratory symptoms
- Cardiac arrhythmias
- Heart attacks
- Premature death

Groups Sensitive to $PM_{2.5}$

- Premature with heart or lung
- Children older adults
- Pregnant women

PPM: Parts per million

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. Primary pollutants