Class 8 Chemistry Combustion and Flame Introduction

Introduction

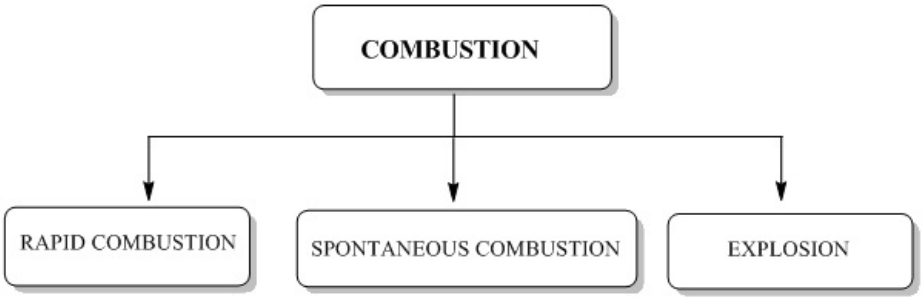
We all need fire to carry out almost all of the chores in our day to day life. We light candles in case of power cut to get heat and light. We also burn wood to conduct bonfire. In all of these cases the substances undergoes burning to give off heat and light. Liquefied petroleum gas, compressed natural gas, petrol, diesel, coal, kerosene etc. are some of the substances that undergoes combustion to give off heat and light. We will discuss the phenomenon of combustion and its related terms below.

Bonfire

On the occasion of Holi, people ignite Bonfires. In it dry woods are ignited and they start burning giving off heat and light. In this process as soon as the woods are ignited the wood catches fire and burns with the help of atmospheric oxygen. This kind of chemical phenomena in which a substance reacts with atmospheric oxygen to give off heat and light is termed as combustion.

Types of combustion

Combustion can be classified into three types namely- Rapid combustion, spontaneous combustion and Explosion.



Rapid Combustion

- The type of combustion reaction that occurs with a great speed producing an enormous heat & light in a short time is known as Rapid combustion.
- For instance, when we bring a matchstick near the gas stove it rapidly catches fire.
- Similarly, as soon as we strike the matchstick against the match box it rapidly catches fire.

Class 8 Chemistry Combustion and Flame — Spontaneous Combustion

Spontaneous Combustion

- The type of combustion reaction that occurs on its own, without the submission of heat is known as Spontaneous combustion.
- For instance, white phosphorus burst into flames spontaneously at the room temperature without the submission of heat.
- Forest fire, spontaneous combustion of coal dust, etc. are some other examples of this kind of combustion.

Class 8 Chemistry Combustion and Flame Explosion

Explosion

- The type of combustion reaction that occurs with the evolution of tremendous amount of heat, light, gases and sound is known as Explosion.
- For instance, when we burn a cracker it bursts with the liberation of tremendous amount of heat, light, gases and sound. It is explosion.

Fuels

The substance undergoing combustion are termed as combustible substances or fuels. In the above example of Bonfire, wood is used as a fuel. In earlier days people used to cook food from the heat liberated by the burning of coal which was used as a fuel. In modern we cook food using LPG cylinders which is fuel and undergoes burning liberating tremendous heat to cook food.

Fuel can be available in three forms.

- Solid fuels: - wood, charcoal, coal, etc.
- Liquid fuels: - petrol, diesel, kerosene, etc
- Gaseous fuels: - compressed natural gas, liquefied petroleum gas, biogas, hydrogen etc.

Ideal Fuel

An ideal Fuel is one which possesses the following characteristics:

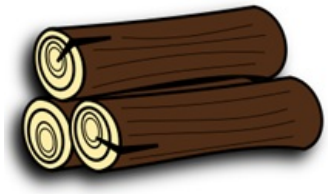
- It should be readily available.
- It should be inexpensive.
- It should burn easily in air at a judicious rate.
- It should liberate large amount of heat.
- It should leave behind any undesirable residues.
- It should be easy enough to store, transport, and handle.
- It should have high calorific value.
- It should have ignition temperature above the room temperature.
- It should produce less hazardous products on burning.

But in reality there is no such fuel that can be regarded as an ideal fuel. We generally opt for the fuel that is capable of meeting maximum of our requirements.

Fuel Efficiency

The amount of energy produced in the form of heat as result of combustion of complete combustion of 1Kg of fuel is known as calorific value of fuel expressed in unit called kilojoule per Kg (kJ/Kg).

Calorific value of some of the fuels are as follows:

Fuel	Calorific Value
Cow dung 	6000-8000
Wood 	17000-22000
Coal 	25000-33000
Petrol	45000

	
Kerosene 	45000
Diesel 	45000
Methane 	50000
CNG 	50000
LPG 	55000

Biogas  	35000-40000
Hydrogen  	150000

Ignition temperature

- The lowest temperature at which a substance catches fire and undergoes combustion liberating heat and light is called ignition temperature.
- In other words it is the minimum temperature at which a combustible substance such as air or gas, must be heated up prior to burning in the absence of any source of the heat. This temperature plays a key role in determining the safety criterions for low volatile products such as diesel oil, lubricating oil, and fuel oil.
- We have already observed that matchstick gets ignited as soon as we strike it against the matchbox whereas it takes a lot of time to ignite a mosquito repellent.

- Similarly kerosene oil does not catch fire on its own at room temperature but as soon as it is heated a little it catches fire. This is because they have different temperature at which they start burning when heat is provided to them.

Inflammable Substances

We can easily notice from my daily life chores that as soon as the knob of the gas stove is turned on and we bring the lighter close to it the LPG released from the stove catches fire. Similarly if we heat the kerosene a little it catches fire whereas burning a piece of wood takes a lot of time and effort. This shows that different fuels have different ignition temperature. Those substances that have very low ignition temperature and easily catches fire and undergoes combustion are termed as inflammable substances. For instance, petrol, alcohol, aerosol sprays, etc.

Class 8 Chemistry Combustion and Flame Requirements to produce Fire

Requirements to produce Fire

The requirements of combustion are as follows:

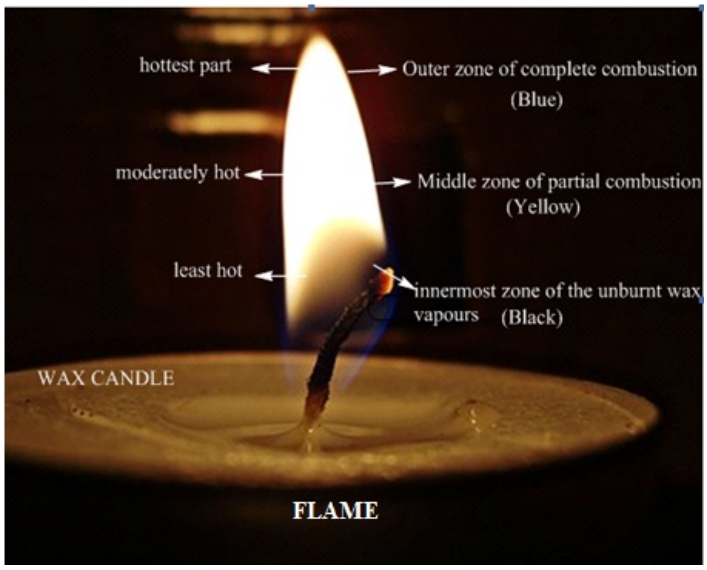
- The first and the most important requirement is the availability of combustible substance or fuel that will be burnt.
- The second but another important requirement for combustion is the availability of air for the provision of oxygen that is the supporter of combustion because combustion cannot take place in the absence of oxygen.
- Last but not the least requirement for combustion is heat in order to attain the ignition temperature. As we learnt above that for combustion it is necessary to attain the ignition temperature.

Bonfire

Class 8 Chemistry Combustion and Flame — Flame and its structure

Flame and its structure

It is the region of combustion of a combustible substance. The substances that vaporises during burning gives off flame. For instance, if a wire is brought near the flame of a burning candle, that portion near the flame becomes black due to deposition of unburnt carbon particles existing in the luminous zone of the flame. Similarly burning of wax and kerosene also vaporises during burning and hence produces flame. But on the other hand charcoal does not vaporise and hence does not produce flames on burning. The following figure shows the different layers of flame.



Class 8 Chemistry Combustion and Flame — Ways to put out fire

Ways to put out fire

Fuel, air and heat are the three mandatory requirements for combustion. Elimination of any one of these requirements will extinguish fire.

- Water can be used to extinguish fire. As water brings down the temperature and hence fire extinguishes in the absence of heat. But this method can only be used if fire is due to wood or paper. If it is an electrical fire then this would be dangerous method to use as water conducts electricity and hence may harm you. This method won't work out in case of oil or petrol fire too as oil floats on water and hence continues to burn.
- In such cases using fire extinguishers will be a brilliant idea as it contains carbon-dioxide. Carbon-dioxide being heavier than oxygen covers the fire and breaks the contact between fire and the oxygen. In addition to this it also cools down the fuel because CO_2 is stored under pressure in cylinders and when released it expands and cools down. Moreover it does not harm the electrical equipment too.

Fire Extinguisher

- Spreading dry powder of chemicals like baking soda or potassium bicarbonate also releases carbon-dioxide.

Fig: Firemen extinguishing petrol fire due to burning of car

Dark side of the burning fuel

Just like coin has a reverse side so as the use fossil fuels too. The excessive use of fossil fuels is a threat to the environment.

- Use of coal and diesel releases Sulphur dioxide which is a foremost cause of acid rain which can lead to mass destruction of monuments made up of brickwork or marbles and can affect the crops as well due to acidification of soil.
- Combustion of fuels also releases carbon-dioxide that is the main cause for the rise in the temperature of earth leading to global warming.
- Use of carbon releasing fuels like wood, charcoal, coal, petroleum releases unburnt carbon particles into the atmosphere that puts the human health at stake. It causes several respiratory diseases in human beings.
- Combustion of these fossil fuels also releases carbon monoxide that's is another harmful, poisonous and suffocating gas that can even cause death if inhaled.