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**UNIVERSITY**  
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PRESENTATION ON

# *INITIATION TECHNIQUES AND INITIATING DEVICES*

CUFS 2416 EXPLOSIVE AND POST BLAST INVESTIGATION

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B.SC. FORENSIC SCIENCE (SEM 6)  
SCHOOL OF FORENSIC SCIENCES  
BHUBANESHWAR CAMPUS

# CONTENT

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- Combustion
- Types of combustion
- Deflagration
- Detonation
- Thermal decomposition
- Explosive train
- Safety fuse
- Detonating cord

# COMBINATION

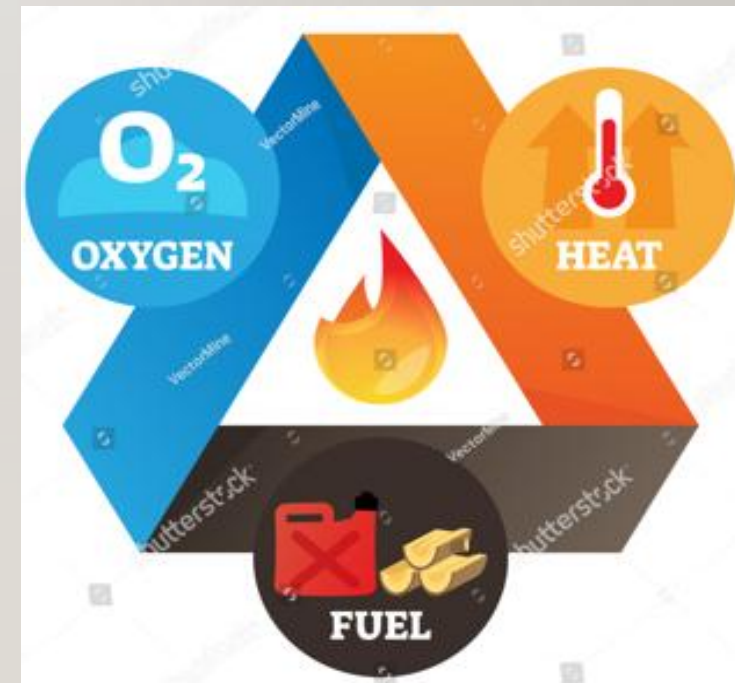
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- Combination is a chemical process in which a substance reacts rapidly with oxygen and gives off heat



They are diverted into two types based on amount of oxygen supply

1. Complete combustion
2. Incomplete combustion



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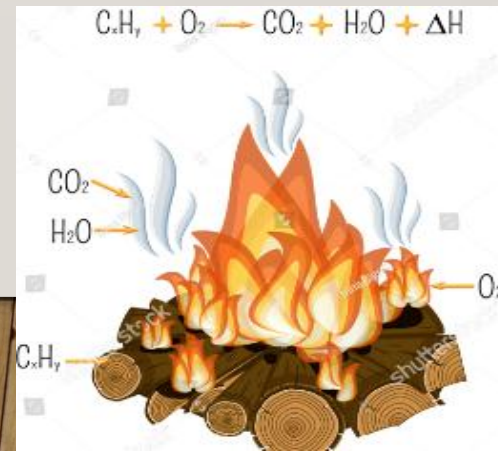
## Complete combustion

- Complete combustion takes place in the presence of a sufficient amount of oxygen.



## Incomplete combustion

- Incomplete combustion takes place when there is insufficient amount of oxygen supply



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- They are divided into three types based on how the reaction happened and produced formed.
    1. Rapid combustion
    2. Spontaneous combustion
    3. Explosive combustion

**Rapid combustion**



**Spontaneous combustion**



**Explosion**



# RAPID COMBUSTION

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- Rapid combustion will take place as long as fuel remains.
- This combustion process gives flame most of the time and used in engines that undergo internal combustion.
- Eg :- wax candle burns as soon as we give external energy by lightning the match stick.
- Burning of LPG in gas stove.



# SPONTANEOUS COMBUSTION

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- Spontaneous combustion doesn't require any external energy to start the combustion process.
- This combustion starts spontaneously at room temperature itself due to self heating.
- This reaction starts because of internal oxidation in the substance which leads to the thermal process, if that particular substance reaches its ignition point temperature and has enough oxygen to start the combustion process the substance starts burning on it's own spontaneously.

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- This kind of reaction mostly happens in those substance which have less ignition temperature.
  - Eg:- many accidents in coal miners are due to spontaneous combustion of coal.
  - Forest fires .





# EXPLOSIVE COMBUSTION

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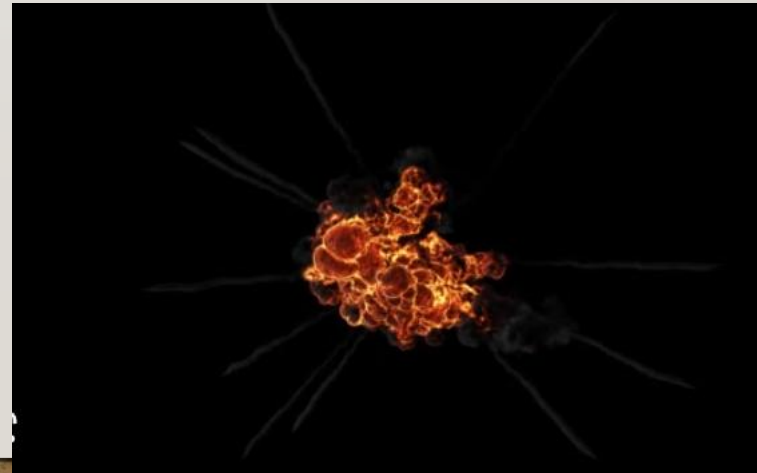
- Explosive combustion happens very rapidly releasing enormous amount of heat, light and sound energy.
- Combustion starts when some energy ignites the substance and heat, light, sound energy release immediately.
- Eg :- Burning of fire crackers
- Dynamite explosion



# DEFLAGRATION

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- Deflagration is a very rapid oxidation reaction accompanied by generation of low intensity pressure wave that can disrupt the surrounding.
- Eg :- Internal combustion engine used in any vehicle that uses fuels such as gasoline, oil or diesel fuel.
- Gunpowder in a firearm
- Fire works and other pyrotechnics.



# DETONATION

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- Detonation means to thunder down or explode
- When decomposition reaction or combustion reaction release a lot of energy in a very short span of time, explosion may occur.
- It's explosion with a resulting shock wave moving at a speed more than the speed of sound.
- Eg :- TNT, RDX

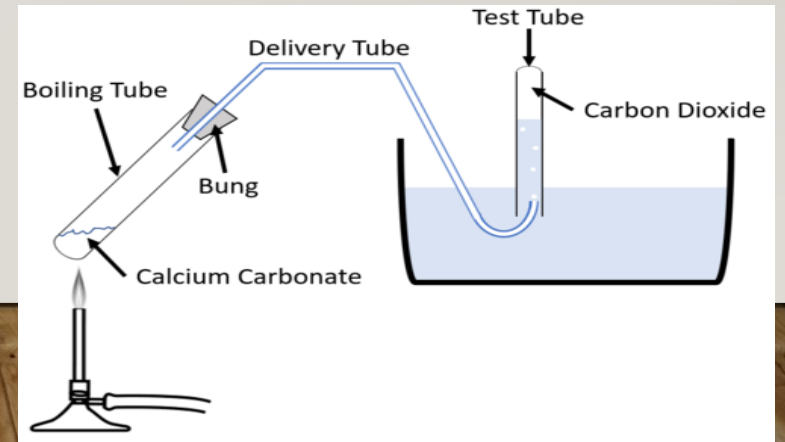


# THERMAL DECOMPOSITION

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- All explosive substance undergoes thermal decomposition at temperatures far below those at which explosion.
- When the rate of heat generation is greater than the rate of heat loss, spontaneous decomposition occurs which is called as ignition.
- Where rate of decomposition rises very slowly at temperatures below 100 c and steepens as the temperature approaches ignition temperature of the explosive, there by decomposition of explosive substance occurs.

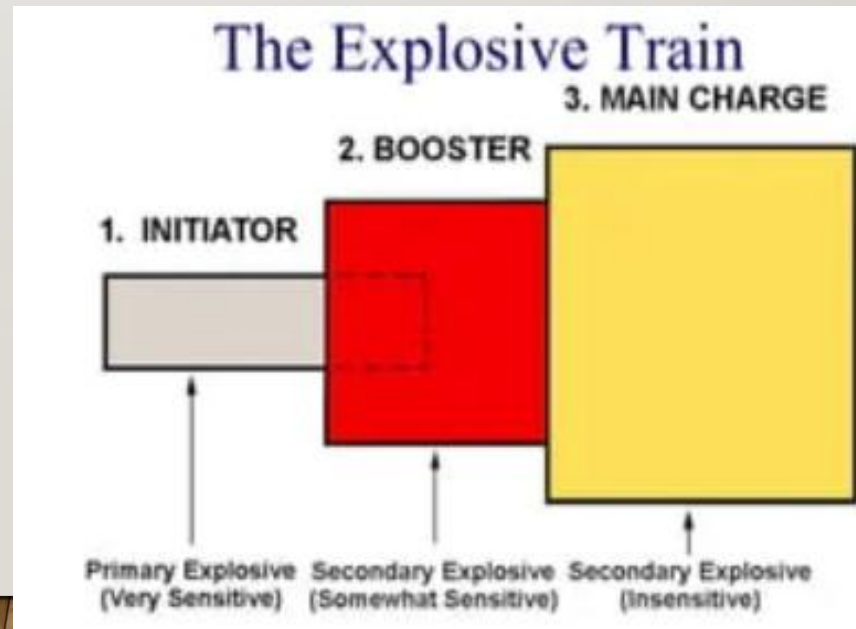
Calcium carbonate  $\longrightarrow$  calcium oxide + calcium dioxide



# EXPLOSIVE TRAIN

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- Explosive train or firing train is a sequence of events which begins with relatively low level of energy that causes a chain reaction to initiate the final explosive or main charge.
- It is divided into two types
  1. Low explosive train
  2. High explosive train



# LOW EXPLOSIVE TRAIN

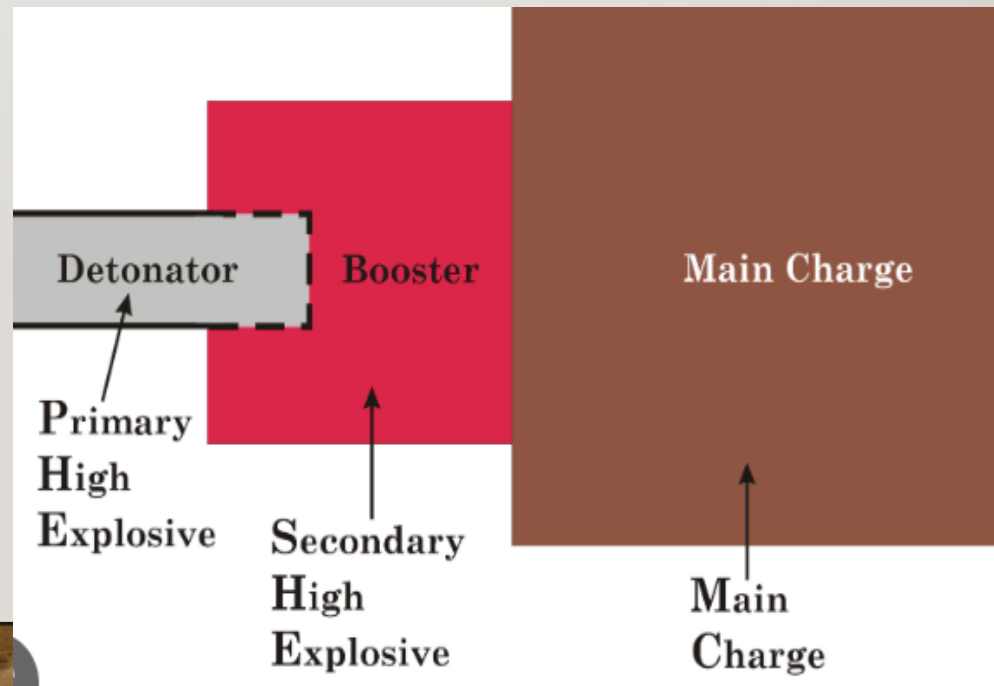
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- For example rifle cartridge which consists of
- A primer consisting of a small amount of primary high explosive which initiates the explosive train.
- Then an igniter which is initiated by the primer and creates a flame that ignites the propellant.
- As the propellant consisting of a secondary low explosive that emits a large amount of gas as it deflagrates.

# HIGH EXPLOSIVE TRAIN

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- High explosive train are divided into two types
  1. Detonators
  2. Dynamites



# DETONATORS

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- A Detonator is a small explosive device for starting a detonation.
- Detonators containing primary explosive.
- Primary explosive requires small quantity of energy to initiate.
- These are extremely sensitive to heat, shock and friction.
- Eg :- lead Azide and mercury fulminate
- Detonation is the transmission through an explosive substance at the speed of 3000 to 9000 meters per second.



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- Detonators are divided into different types such as

1. Fulminate based detonator
2. Lead Azide based detonator

### **Fulminate based detonator**

- It contains 80% of mercury fulminate and 20% of potassium chlorate .
  - These are affected in moisture condition.
  - These produces very weak initiation so these are no longer used now a days.
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# LEAD AZIDE BASED DETONATOR

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- These are ignited by safety fuse.

They divided into two types

1. Plain Detonators
2. Electric Detonator

# PLAIN DETONATORS

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- It is 6mm tube of Aluminum
- Its length is 32 mm , thickness is 0.3 mm
- It's 1/3 part of tube is filled with base charge and prime charge.
- Where as base charge contain PETN and prime charge contain ASA(lead azide + lead Styphnate + Al powder.
- Saw dust is filled at top portion.

# ELECTRIC DETONATOR

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- In electrical detonator there is a filament or bridge wire which, work like the filament of the bulb of flash light, heat up when current flows through it.
- The heat ignites the flash charge.

The electric detonator is divided into two types

1. Ordinary electric detonator
2. Delay electric detonator

# ORDINARY ELECTRIC DETONATOR

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- These are ignited by electric current
- On the basis of flashing mixture and electric circuit they are divided into two types
  1. Low tension electric detonator
  2. High tension electric detonator

# LOW TENSION ELECTRIC DETONATOR

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- In low tension electric detonator 2 brass foils are connected unequal length.
- These brass foils are connected through Ni –Cr wire bridge in flashing mixture.
- Internal resistance (including leading wires)- less than 1ohm.
- Current required is 0.5A is required to ignite the fuse.
- Minimum voltage required is 3.5V

# HIGH TENSION ELECTRIC DETONATOR

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- In high tension electric detonator 2 brass foils are connected equally length.
- Flashing mixture contain LMNR, potassium chlorate, charcoal, Nitrocellulose, copper acetylide, graphite powder.
- Graphite powder in the flashing mixture act as chemical bridge b/w the end of brass foils.
- Internal resistance (including leading wires is 1000 ohm to 3000ohm.
- Minimum current required is 0.025A
- Minimum voltage required is 50V.

# DELAY DETONATOR

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- These are ignited by electric current.
- It contains a delay element below flashing mixture and above primer charge.

They are divided into two types

1. Half second delay detonator
2. Milli second delay detonator



# HALF SECOND DELAY DETONATOR

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- These are called as long delay detonator.
- Delay elements contains antimony and potassium permanganate .
- These are available in 0-10 delay numbers
- The leading wires is red and other one is yellow colour.
- Half second delay detonator are used in under ground operation as long delay time are needed to break and thrown from the tunnel.
- HS detonator are prohibited to use in surface operation as the delay time are too long and cause rocks to fly.

# MILLI SECOND DELAY DETONATOR

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- These are called as short delay detonator .
- The delay elements contains red lead and silicon.
- These are available in 0-15 delay numbers.
- 0.25 second interval between two consecutive delay numbers.
- Milli second delay detonator are used in surface operation mostly.
- Both the leading wires are in red colour.

# NON ELECTRIC DETONATOR

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- A non-electric detonator is a shock tube detonator designed to initiate explosions.
- It generally used for the purpose of demolition of buildings and blasting of rocks in the mines and quarries.
- In a non electric detonator at one side it is opened and connected with a safety fuse and crimps it.
- The flash from the fuse ignites a flash or ignition charge of lead Styphnate and barium chlorate.
- This will initiate a priming charge of lead azide that is primary explosive.

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- That initiate the base charge which consists of PETN, HMX and TNT.
  - Instead of electric wires a hollow plastic tube delivers the foreign impulse to the detonator.

# DYNAMITE

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- Dynamite containing secondary explosive
- These are insensitive to shock , friction, and heat.
- These are less sensitive than primary explosive.
- E.g.:- PETN ,RDX etc.
- It contains primary component, secondary components, tertiary components.

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## **Primary components**

- It contains 3 primary high explosive components which are used to initiate explosive
- They are fuse, primer, and detonator.

## **Secondary component**

- Secondary components contains boosters.

## **Tertiary components(contains main charge)**

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- As the main charge is insensitive sometime so explosive boosters is used to deliver a sufficient shock wave to success fully initiate the main charge,as so full detonation occurs.
  - E.g. :- ANFO( Ammonium nitrate and fuel oil)

# EXPLOSIVE INITIATING / IGNITING SYSTEM

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These are two types

1. Fuse System
2. Detonator system

## **Fuse system**

This is divided into two types

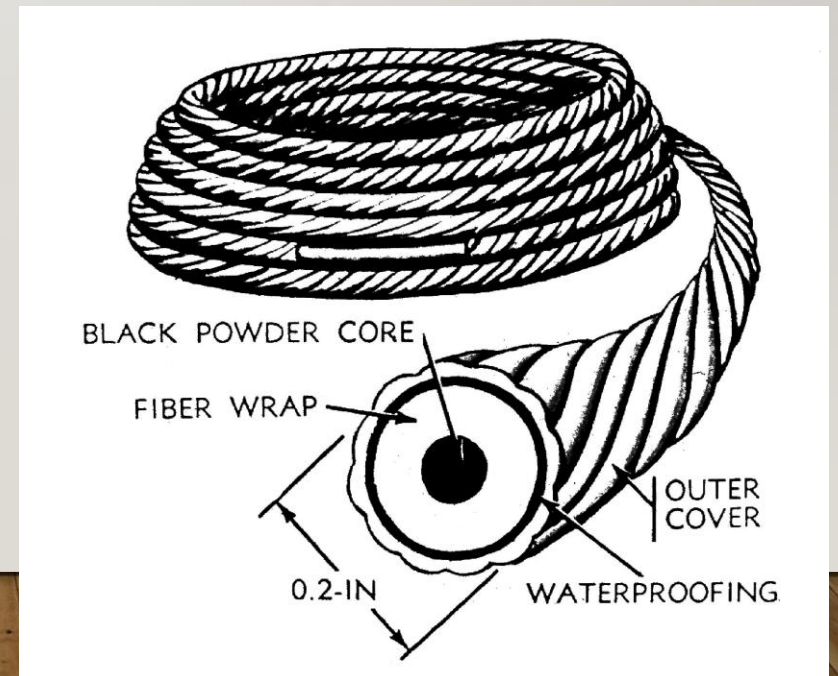
1. Safety fuse
2. Detonating cord



# SAFETY FUSE

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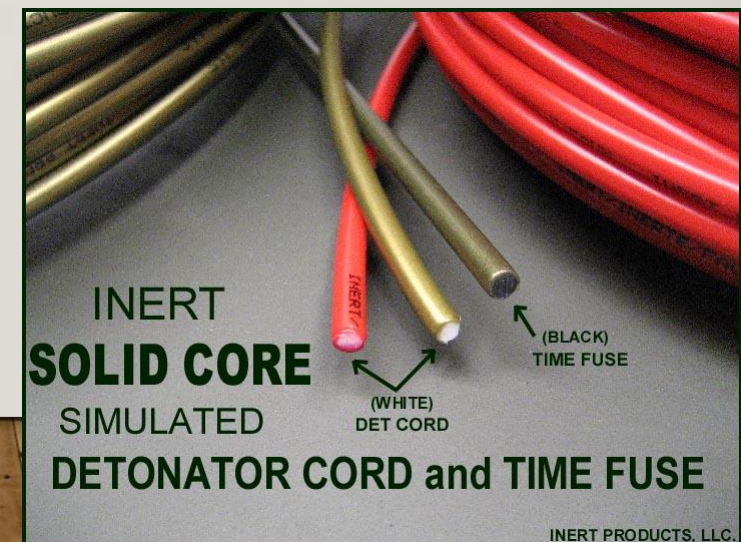
- Safety fuse introduced by William Beckford in the year 1831.
- Safety fuse look like a card
- The inner core is filled with gunpowder/black powder.
- The outer layer has waterproof coating.
- The burning speed of safety fuse is 100 -125 sec/meter.



# DETONATING CORD

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- Detonating cord looks like a cord having diameter 5 mm.
- It is made of plastic.
- It is filled with 11 gm of PETN or TNT per metre.
- It has different varieties of length of 100m,200m,300m are available.
- It's burning speed is 7000m/s.
- It is used for deep hole blasting in open cast mines.



**THANK YOU.**

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