



SNS COLLEGE OF TECHNOLOGY

Vazhiampalayam, Coimbatore-35

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DEPARTMENT OF CHEMISTRY

COURSE NAME : 19CHB101- CHEMISTRY FOR ENGINEERS

I YEAR / I SEMESTER

UNIT : 3. FUELS AND COMBUSTION

**TOPIC : 5. KNOCKING, ANTI-KNOCKING, OCTANE AND
CETANE NUMBER**



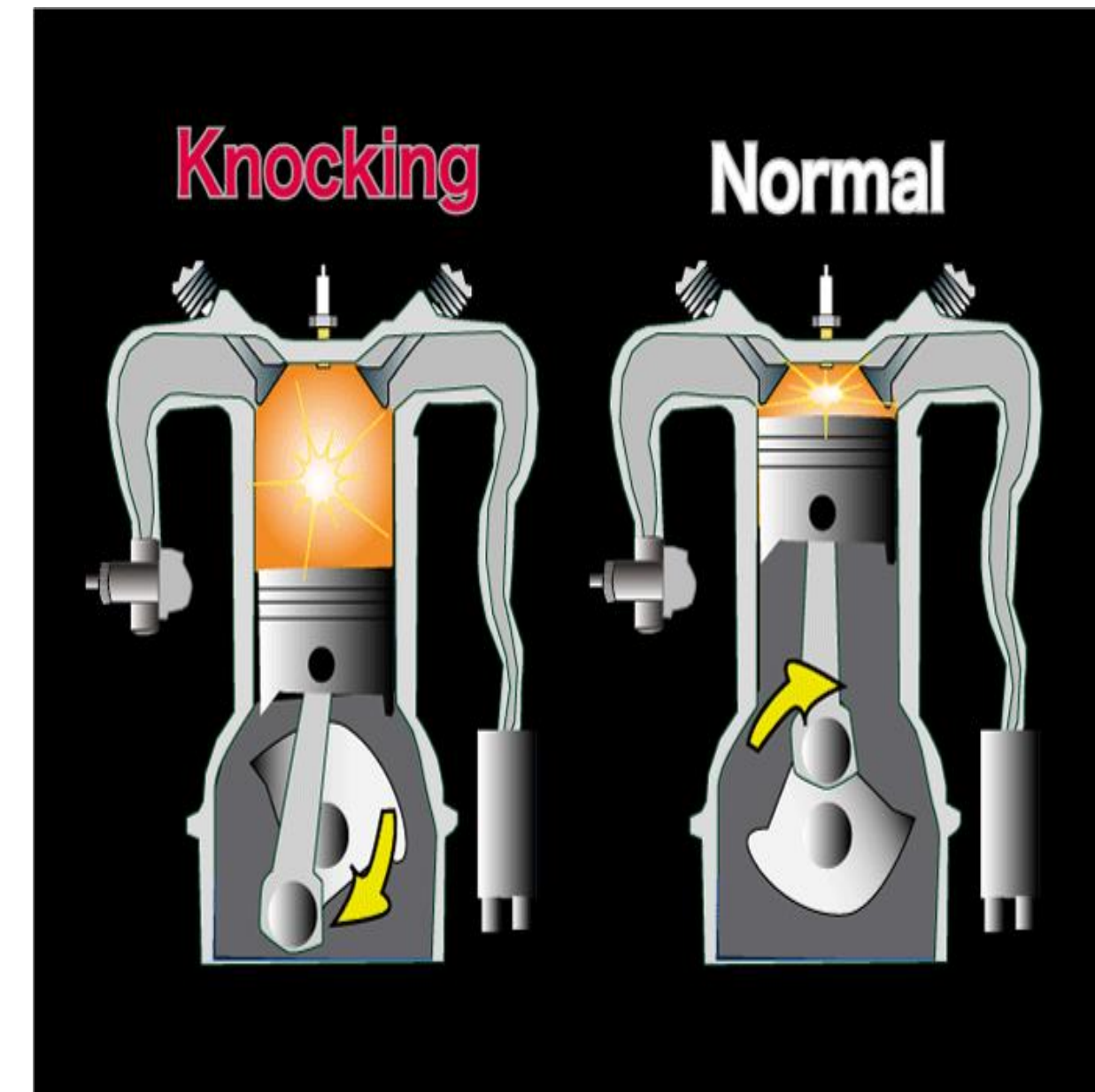
BRAINSTORMING WITH RECAP



KNOCKING



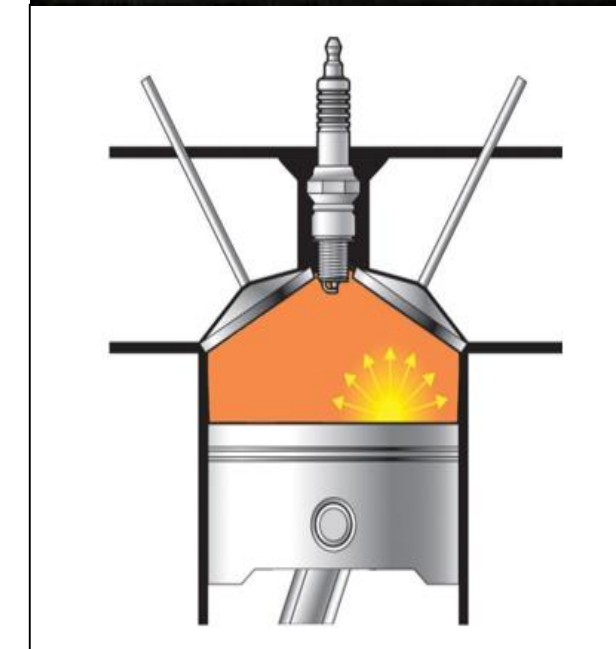
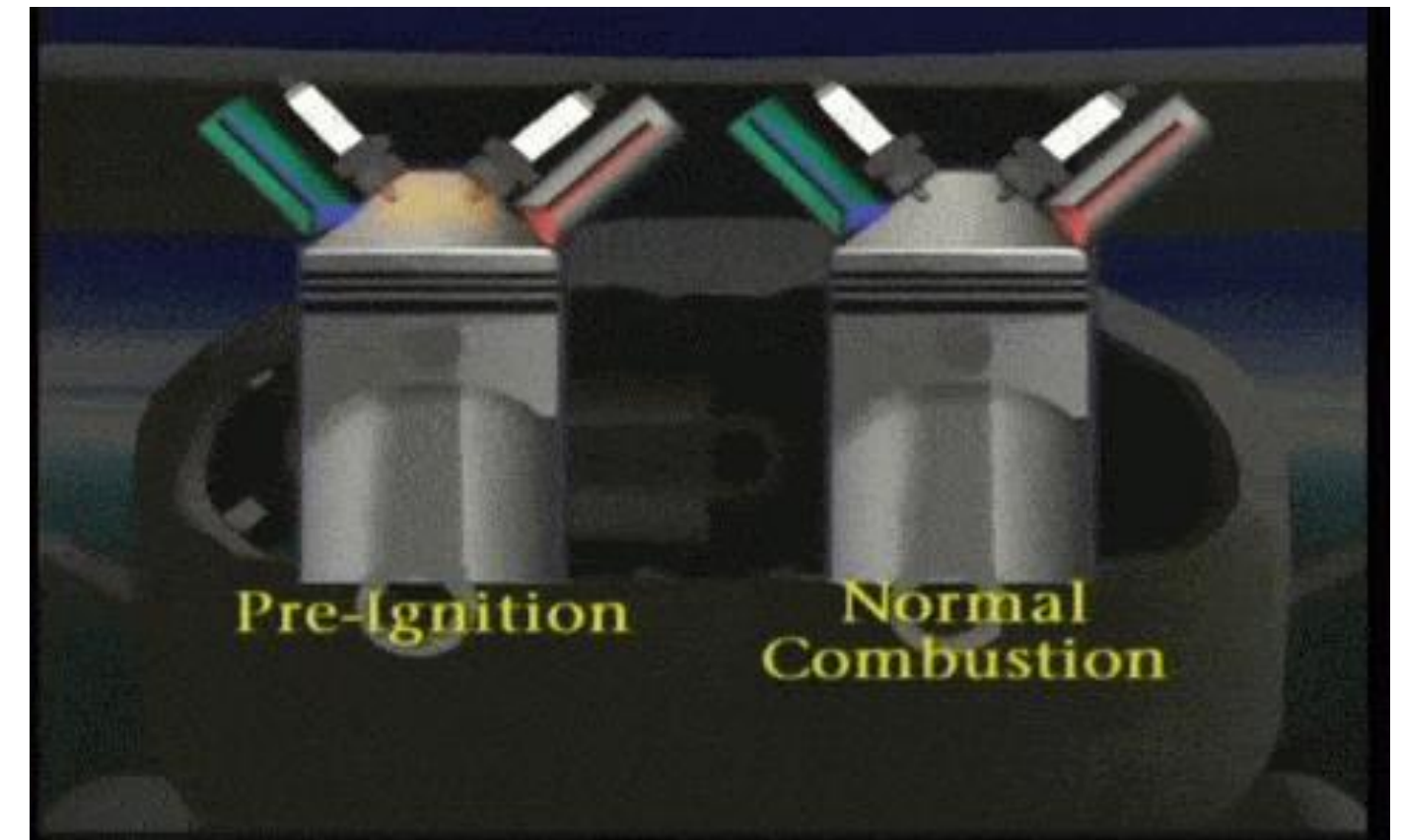
- It is a kind of explosion due to rapid pressure rise occurring in an IC engine.
- It Causes of knocking in S.I Engine [Petrol engines]
- In a petrol engine, a mixture of gasoline vapour and air at 1: 17 ratio is used as fuel.
- This mixture is compressed and ignited by an electric spark.
- The products of oxidation reaction (combustion) increases the pressure and pushes the piston down the cylinder.
- If the combustion proceeds in a regular way, there is no problem in knocking.





KNOCKING

- But in some cases, the rate of combustion (oxidation) will not be uniform due to unwanted chemical constituents of gasoline.
- The rate of ignition of the fuel gradually increases and the final portion of the fuel-air mixture gets ignited suddenly producing an explosive sound known as "Knocking".
- Knocking property of the fuel reduces the efficiency of engine.
- A good gasoline should resist knocking.



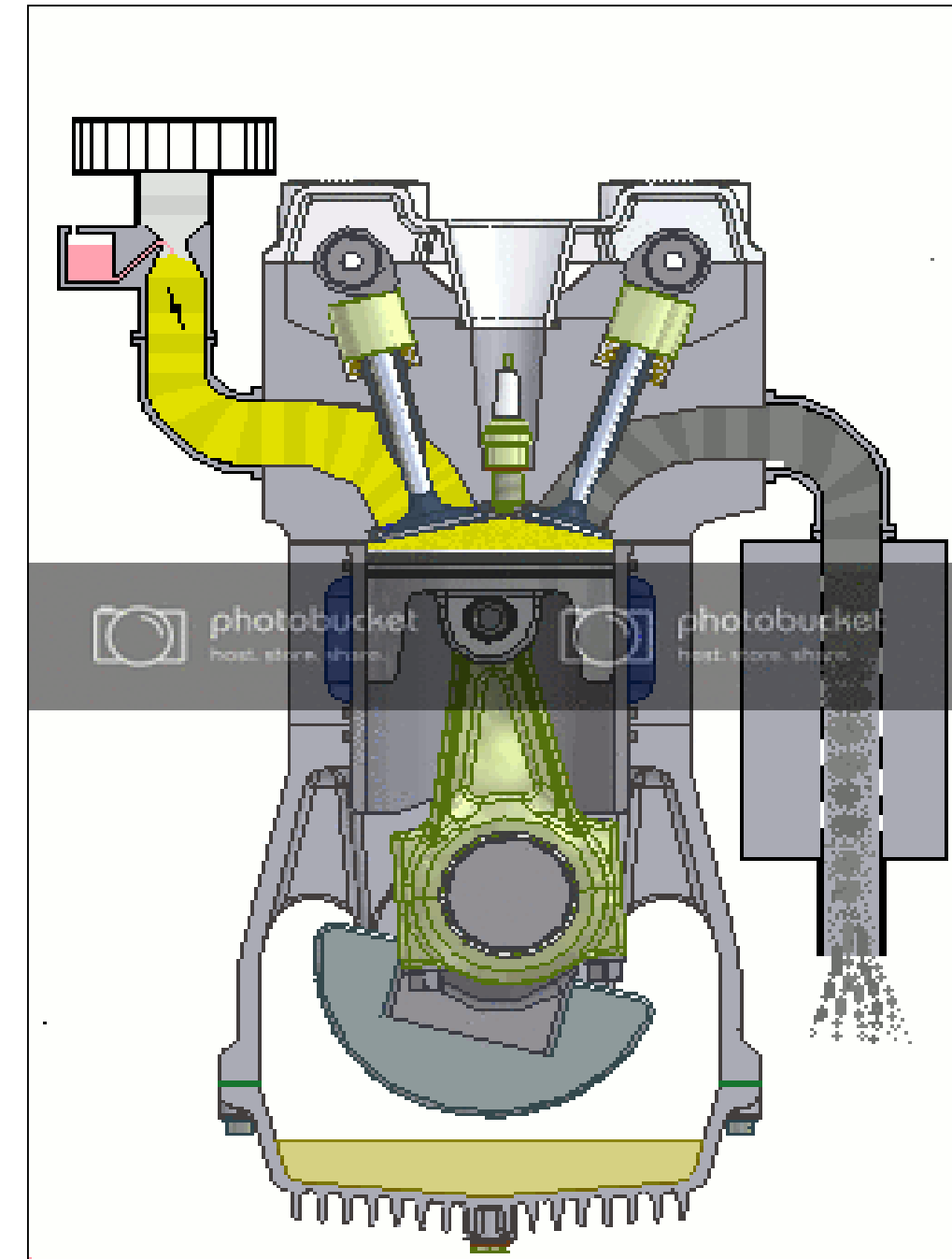


KNOCKING

- **Chemical structure and knocking**
- The knocking tendency of fuel hydrocarbons mainly depends on their chemical structures.
- The knocking tendency decreases in the following order.
- **Straight chain paraffins > Branched chain paraffins > Cycloparaffins > Olefins > Aromatics.**

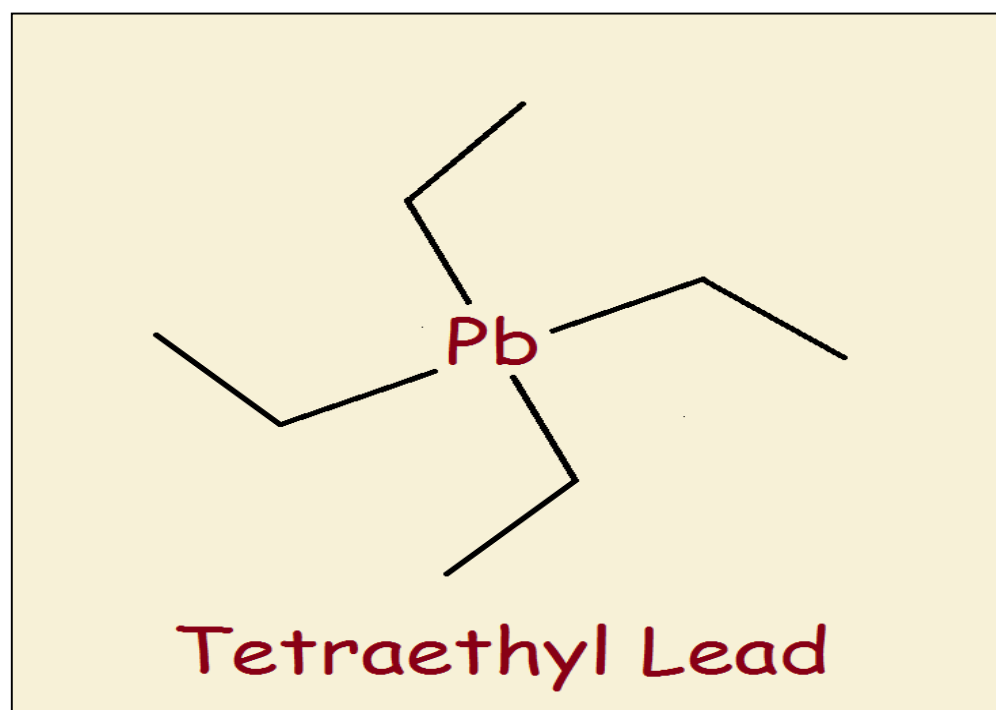
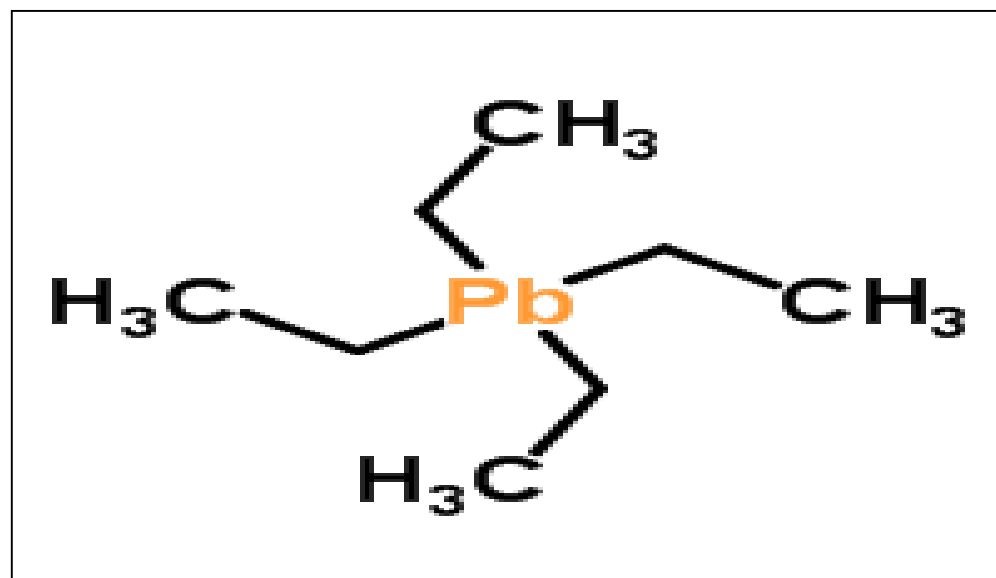
The octane number of fuel can be improved by

- Blending petrol of high octane number with petrol of low octane number, so that the octane number of the latter can be improved.
- The addition of anti-knock agents like Tetra-Ethyl Lead (TEL).





ANTI-KNOCK AGENT



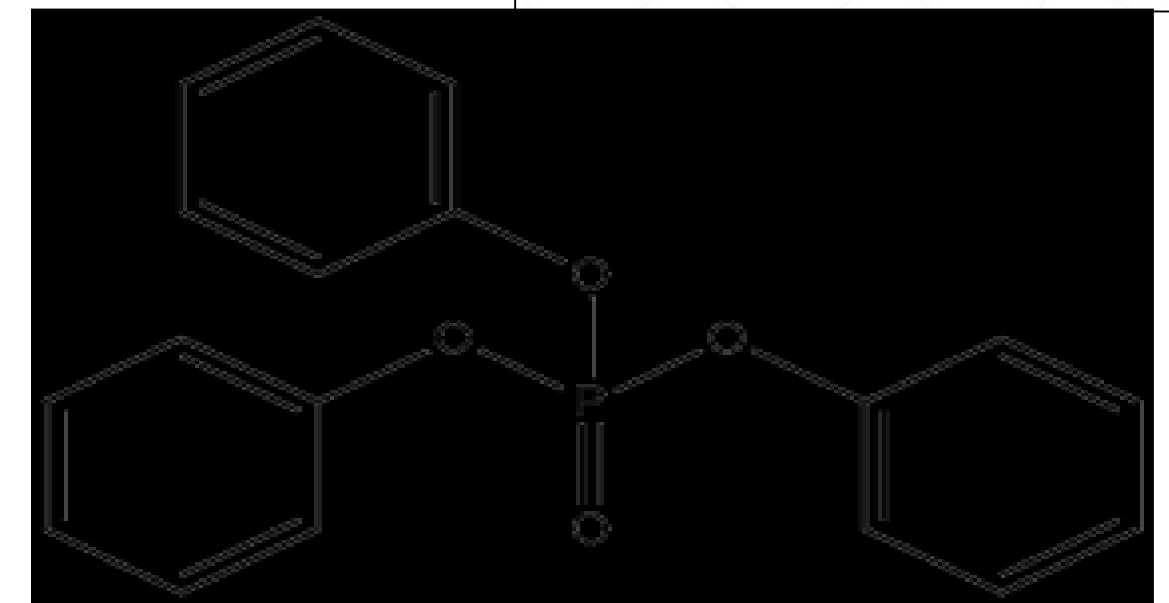
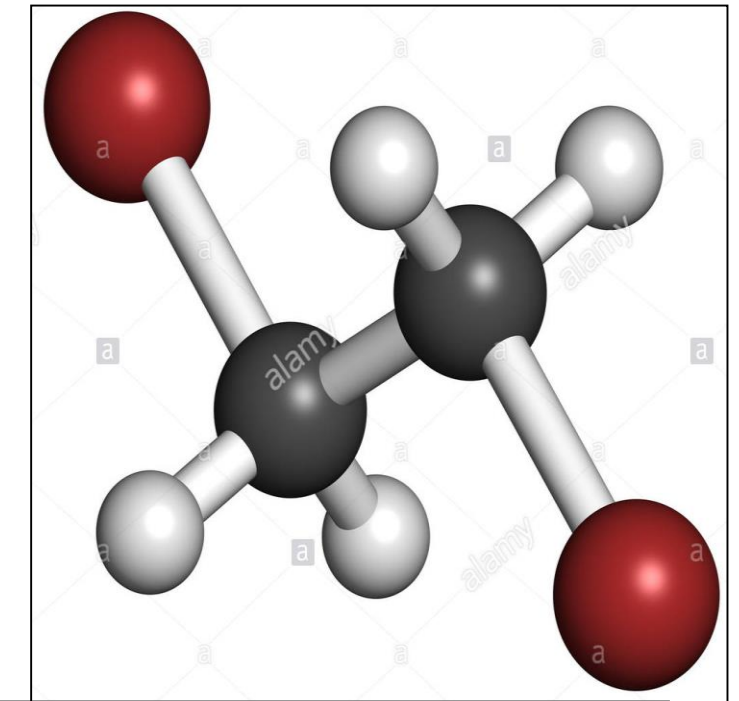
LEADED PETROL

- The anti-knock properties of a gasoline can be improved by the addition of suitable additives.
- **Tetraethyl lead (TEL) or (C₂H₅)₄ Pb** is an important additive added to petrol
- The petrol containing tetra ethyl lead is called **leaded petrol**.
- **TEL** reduces the knocking tendency of hydrocarbon.
- **Knocking follows a free radical mechanism**, leading to a chain growth which results in an explosion.
- **If the chains are terminated** before their growth, **knocking will cease**.
- TEL decomposes thermally to form ethyl free radicals which combine with the growing free radicals of knocking process and thus the **chain growth is stopped**.



ANTI-KNOCK AGENT

- **Disadvantages of using TEL**
- When the leaded petrol is used as a fuel, the **TEL is converted to lead oxide and metallic lead.**
- This **lead deposits on the spark plug** and on cylinder walls which is **harmful to engine life.**
- To avoid this, small amount of **ethylene dibromide is added along with TEL.**
- This ethylene dibromide reacts with Pb and PbO to give **volatile lead bromide**, which goes out along **with exhaust gases.**
- But this creates **atmospheric pollution.**
- So nowadays **aromatic phosphates** are used as antiknock agent instead of TEL, it avoids lead pollution.





Activity



- Peter's father has five sons. The names of four sons are Fefe, Fifi, Fafa and Fufu respectively. What is the name of the fifth son?

Fefe
Fifi
Fofu
Fufu

Ans : Peter's father has five children and four of them have already been named above. The fifth son is Peter himself.

- Find the right lock for the key! 



- **Ans :** It was a great brain teaser for treasure hunters! The key fit only the lock of chest number 4.

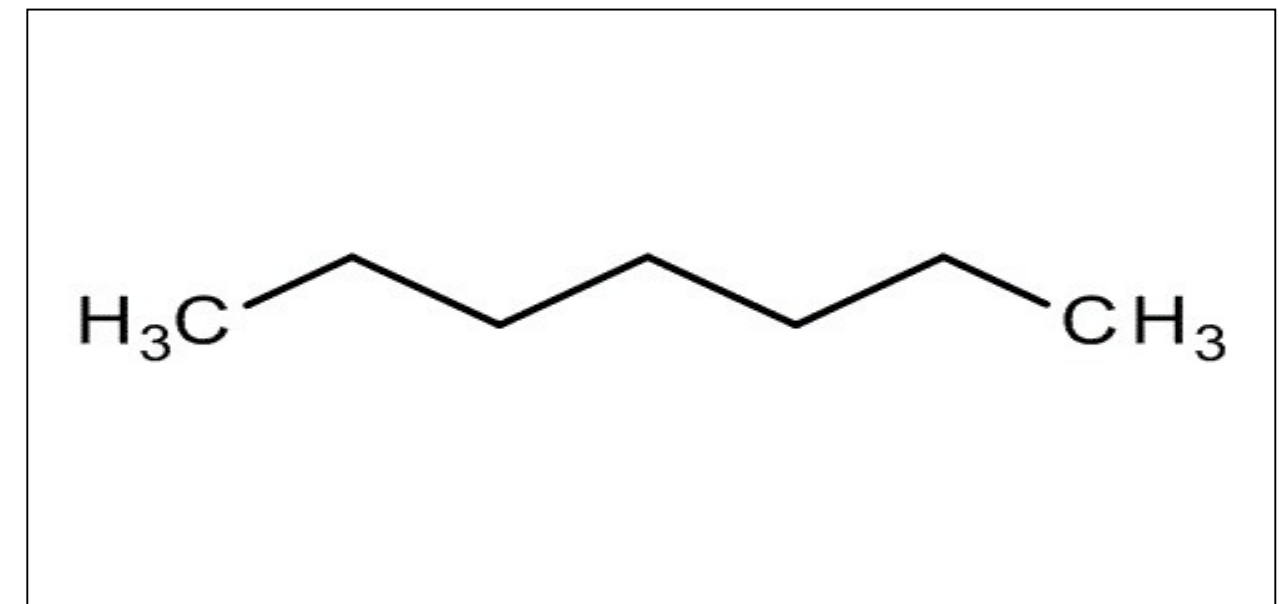
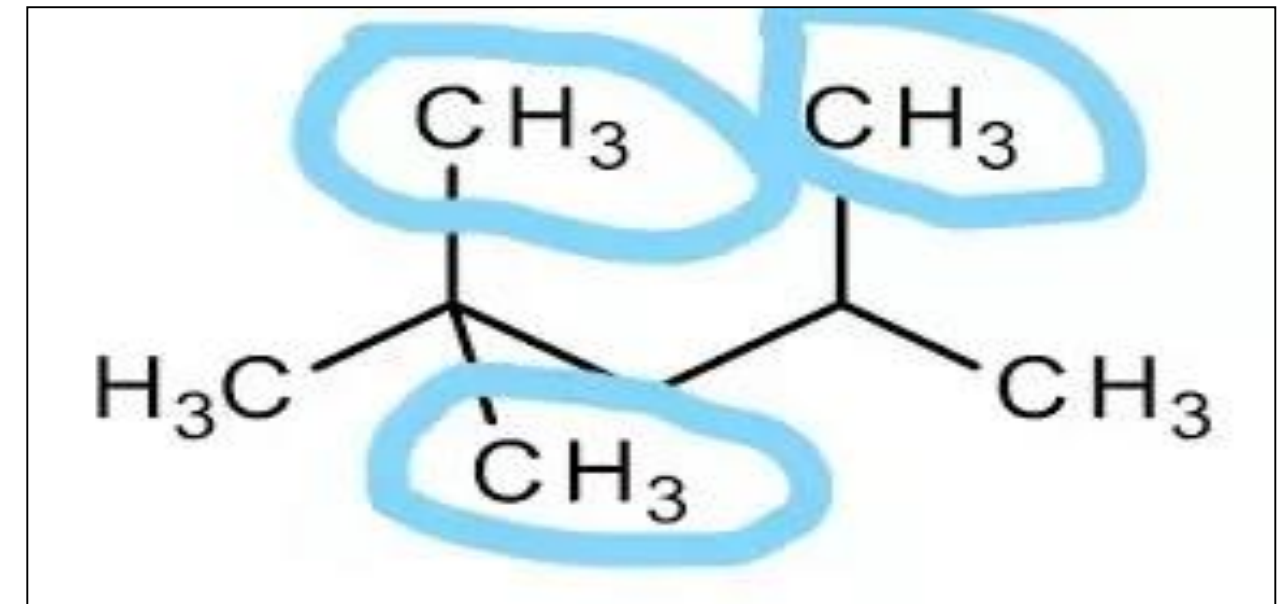


OCTANE NUMBER



- Octane numbers are based on a scale on which isooctane is 100 (minimal knock) and n-[heptane](#) is 0 (bad knock).
- The higher the octane number, the more compression required for fuel ignition.
- Fuels with high octane numbers are used in high performance gasoline engines.
- Fuels with low octane number (or high cetane numbers) are used in diesel engines, where fuel is not compressed.

Octane number is defined as 'the percentage of iso-octane present in a mixture of iso-octane and n-heptane.'





CETANE NUMBER (or) CETANE RATING

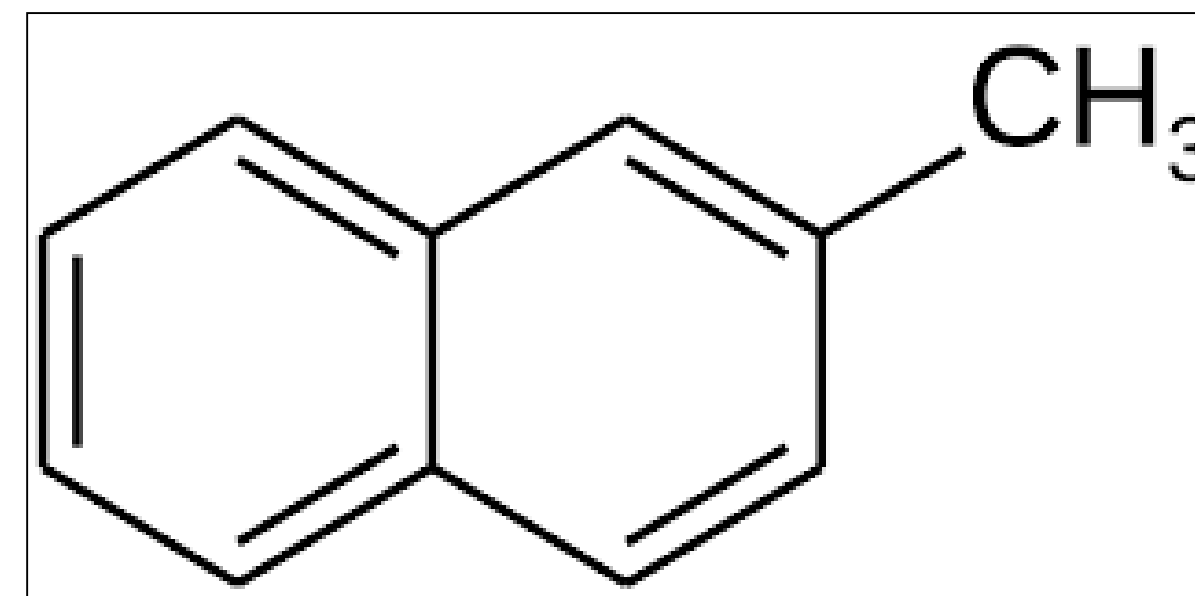
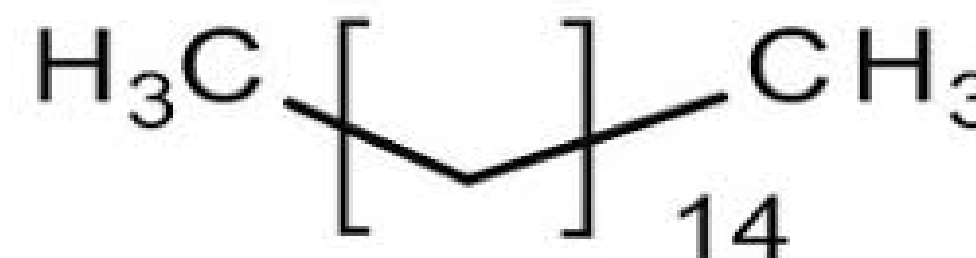


- Cetane number is a measure of the ignition value of a diesel fuel.
- It is introduced to express the knocking characteristics of diesel.
- Cetane has a very short ignition lag and hence its cetane number is taken as 100.
- On the other hand 2-methyl naphthalene has a long ignition lag and hence its cetane number is taken as zero.

The percentage of hexa decane present in a mixture of hexa decane and 2-methyl naphthalene, which has the same ignition lag as the fuel under test".

The cetane number decreases in the following order.

n-alkanes > Cycloalkanes > alkenes > branched alkanes > aromatics





SUMMARY



REFERENCES



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THANK YOU