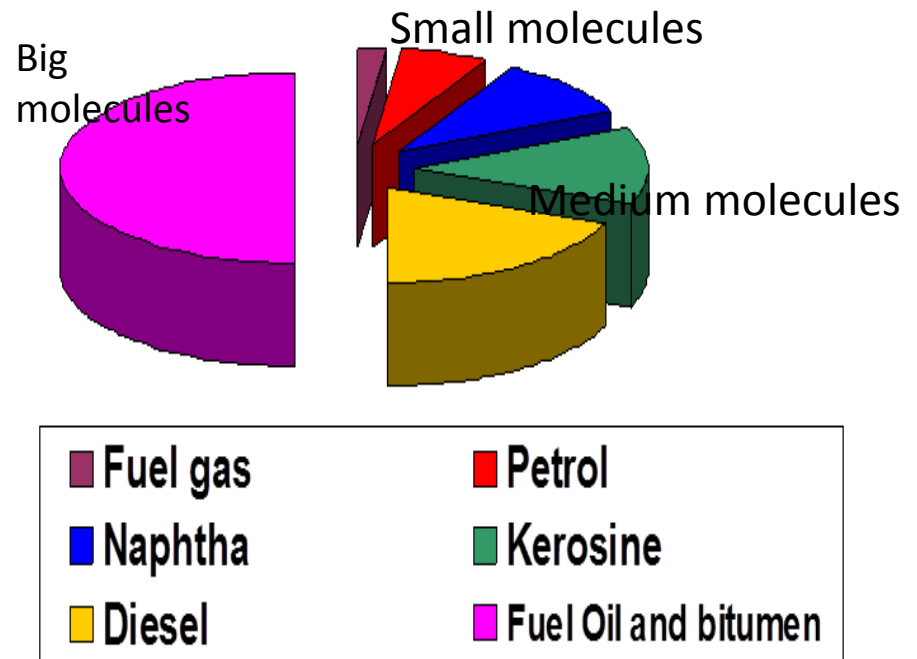


Cracking

- Crude oil contains many large molecules. If these are to be used as fuels or feedstock for the chemical industry then they have to be cracked into smaller molecules.
- When hydrocarbons burn they are reacting with oxygen in the air. In general, the smaller the molecule the better it will mix and then react with the air.



Cracking

- Involves the breaking of C-C bonds in alkanes
- Converts heavy fractions into higher value products
-
- THERMAL proceeds via a free radical mechanism
- CATALYTIC proceeds via a carbocation (carbonium ion) mechanism

Thermal Cracking

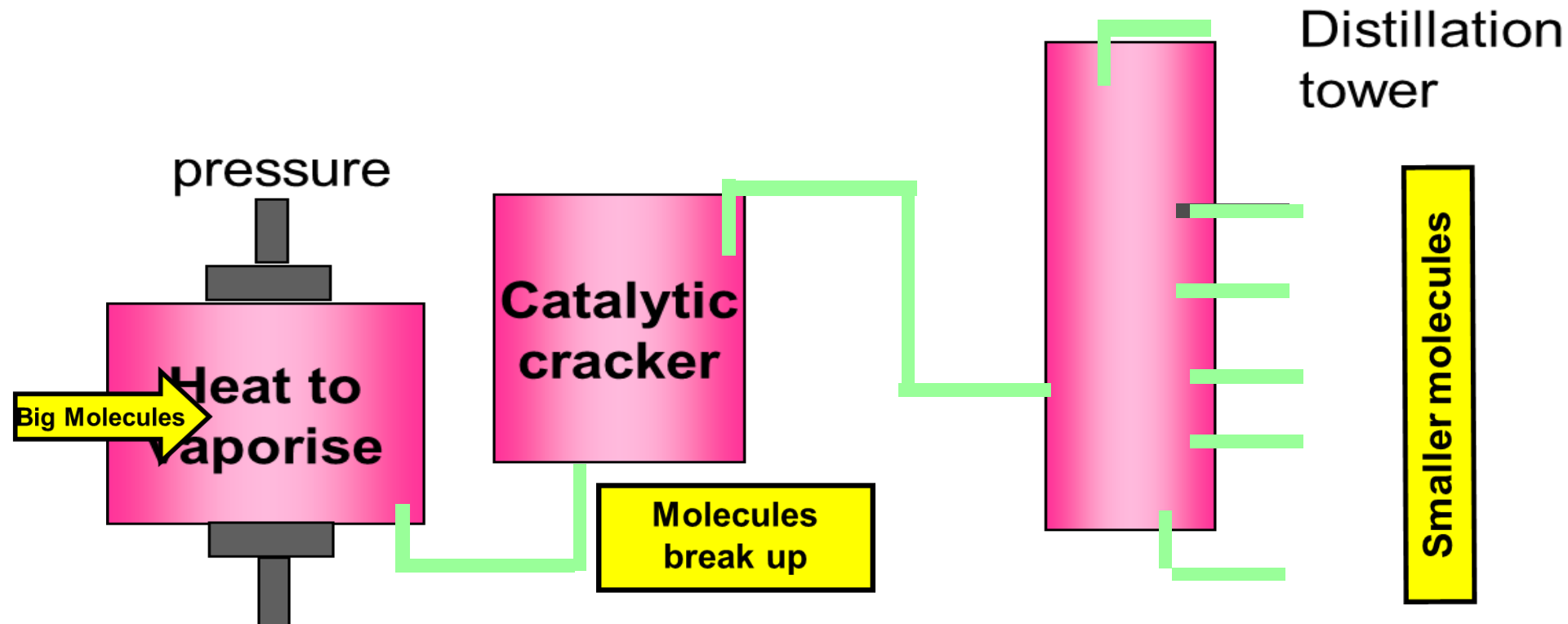
- High Pressure ... 7000 kPa
- High Temperature ... 400°C to 900°C
- Free Radical Mechanism
- Homolytic fission
- Produces mostly alkenes ... e.g. ethene for making polymers and ethanol
- Produces Hydrogen ... used in the Haber Process and in margarine manufacture
- Bonds can be broken anywhere in the molecule by C-C bond fission or C-H bond fission

Catalytic Cracking

- Slight pressure
- High Temperature ... 450°C
- Zeolite catalyst
- Carbocation Mechanism
- Heterolytic fission
- Produces branched and cyclic alkanes, aromatic hydrocarbons
- used for motor fuels
-
- **ZEOLITES are crystalline aluminosilicates; clay like substances**

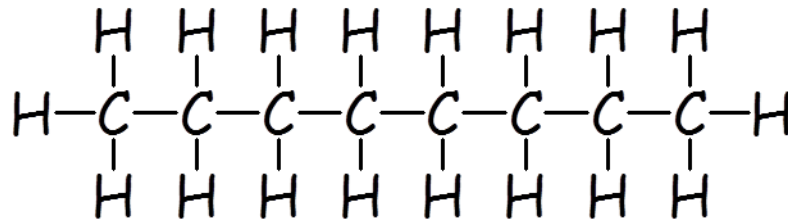
Catalytic Cracking

- Large hydrocarbons are broken into smaller molecules using heat and a catalyst.
- This process is known as catalytic cracking.
- The small molecules produced are then separated by distillation.



Catalytic Cracking

- In the catalytic cracker long chain molecules are 'cracked'. An example of such a reaction is:

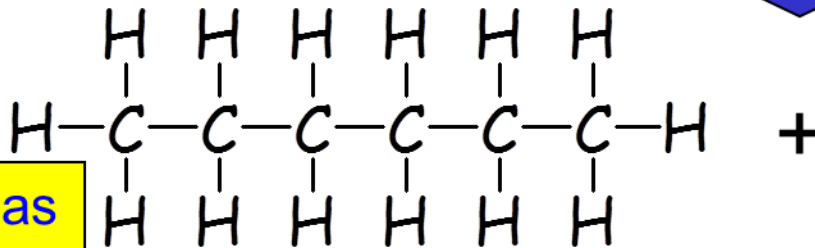


Octane

hexane

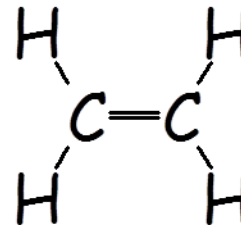
Heat
pressure

catalyst



Used as
a fuel

+



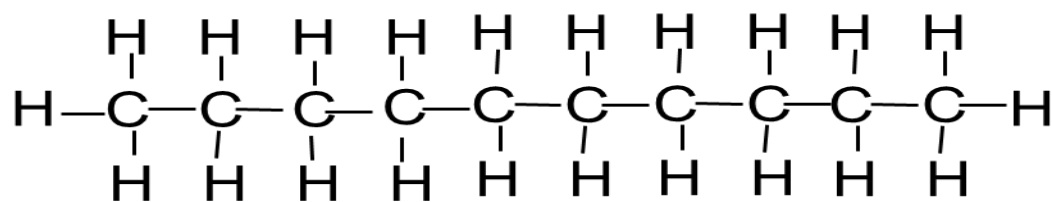
ethene

Ethene
is used
to make
plastics



Activity

- Draw out displayed formulae of a pair of products formed by cracking decane
- Draw out displayed formulae of a pair of products formed by cracking decane

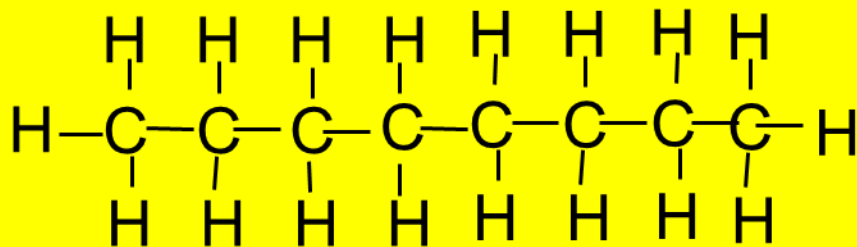


decane

Heat
pressure

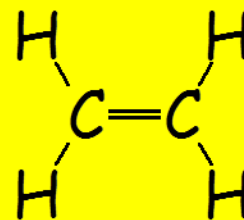


catalyst



octane

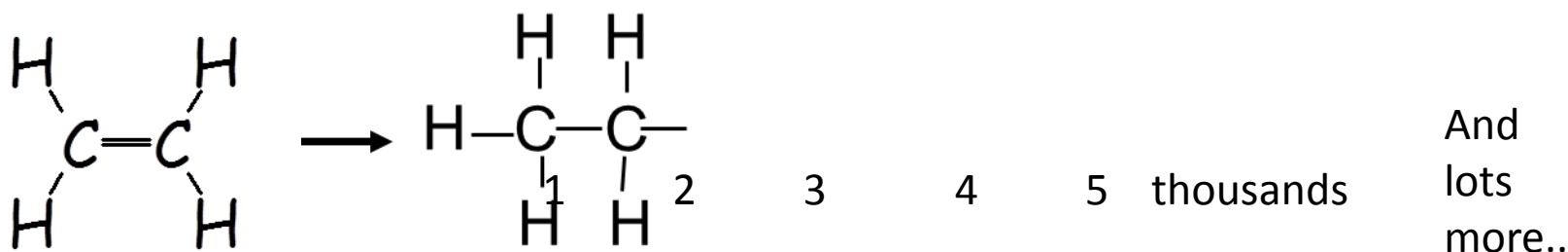
+



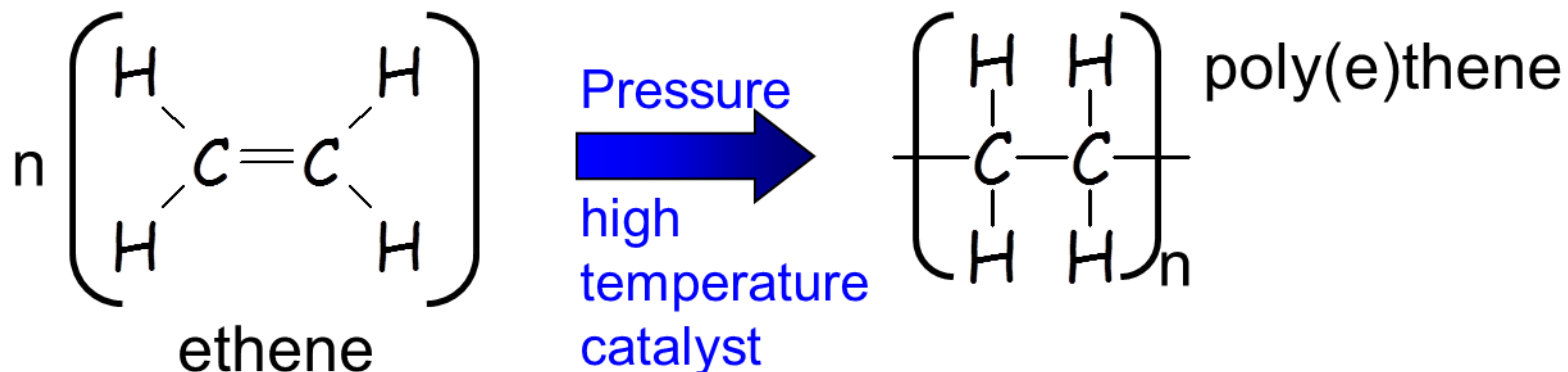
ethene

Poly(e)thene

- One important reaction of alkenes involves the joining together of alkene molecules.

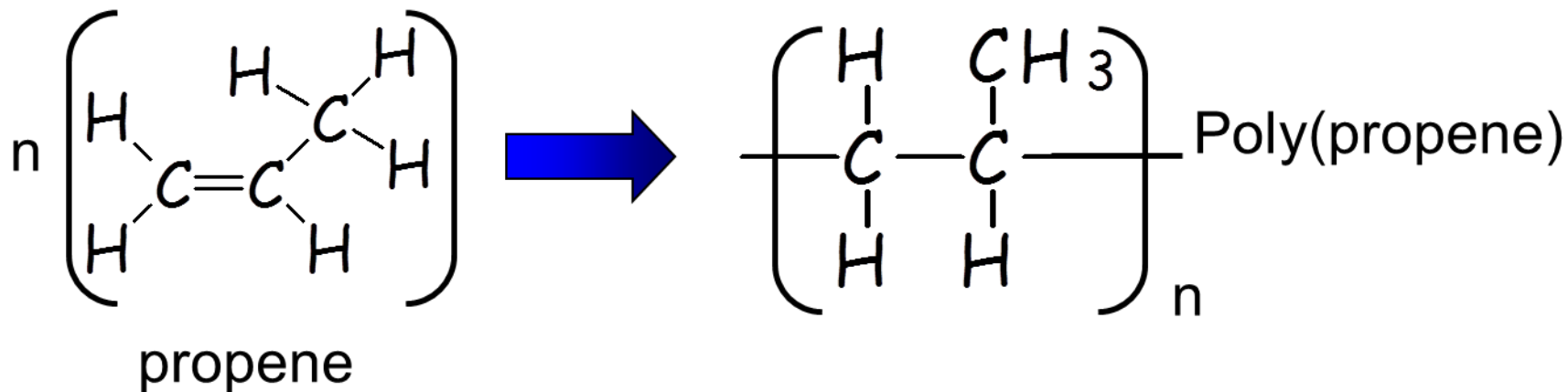


This is called addition polymerisation and is written as:



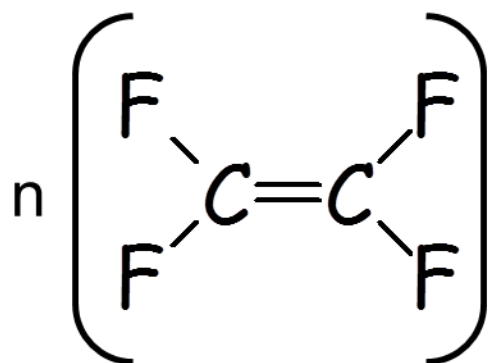
Polypropene

- Ethene is only one alkene. Other unsaturated molecules such as propene, vinyl chloride and styrene can also be polymerised to produce a range of plastics. E.g. propene

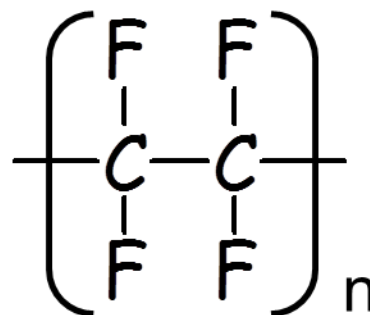


PTFE

- Tetrafluoroethane is another alkene that is made into an important plastic used to coat non-stick pans: polytetrafluoroethane or PTFE.



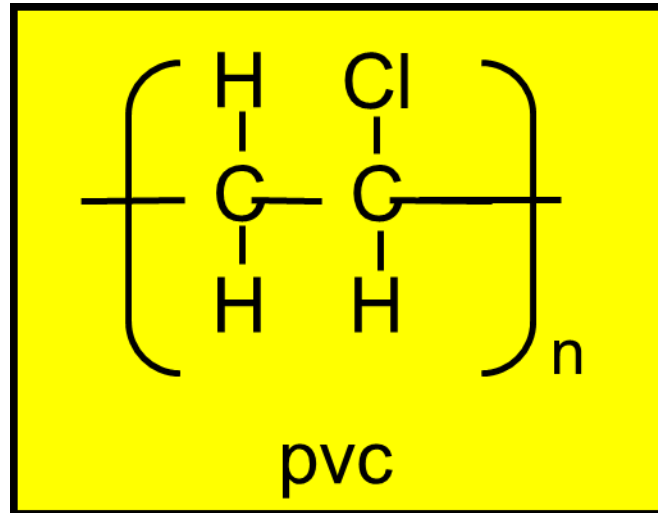
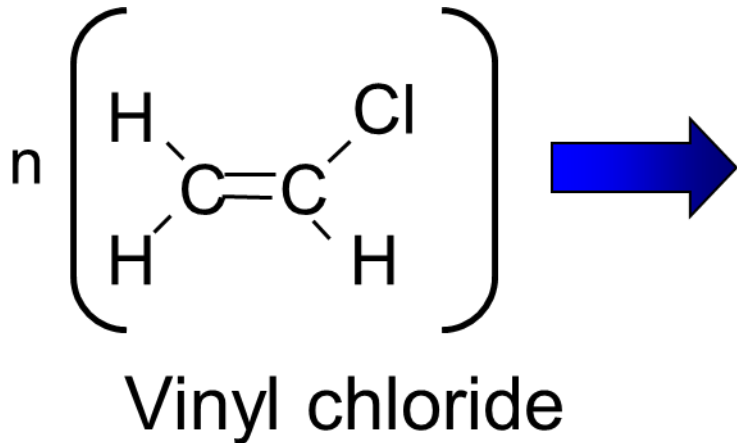
tetrafluoroethene



Poly(tetrafluoroethane)
or PTFE

Activity

- Fill in the products that will be obtained from vinyl chloride



Some uses of plastics

Poly(e)thene

Shopping bags

Bottles

Buckets

Washing up
bowls



Polypropene

Milk crates

Rope

Carpet fibres



Polystyrene

packing

insulation

Ball pens



Answers

Across	Down
3) separate substances with different boiling points	1) Contain a double bond
7) saturated hydrocarbon	2) a series of molecules differing by a CH ₂
8) joining of many small molecules	4) breaking up a large molecules
9) full up: unable to add more atoms	5) the different substances collected from distillation
	6) used to test for unsaturated molecules.

Across	Down
3) separate substances with different boiling points DISTILLATION	1) Contain a double bond ALKENE
7) saturated hydrocarbon ALKANE	2) a series of molecules differing by a CH ₂ HOMOLOGOUS
8) joining of many small molecules POLYMERISE	4) breaking up a large molecules CRACKING
9) full up: unable to add more atoms SATURATED	5) the different substances collected from distillation FRACTIONS
	6) used to test for unsaturated molecules. BROMINE

- Which of these is an alkane?
- C_6H_{14}
- C_4H_8
- $\text{C}_{12}\text{H}_{24}$
- $\text{C}_{102}\text{H}_{204}$

- Which of these is a true statement about
- alkenes?
- They turn bromine water from colourless to red
- They contain a double bond
- The smallest alkene has 1 carbon atom
- They have names that end in “ane.”

- Which of these is a true statement about cracking?
- it is the separation of molecules into fractions of different sizes.
- it is carried out at low temperatures
- it uses a catalyst.
- It produces polymers

- Which of these is a true statement about polymerisation?
- it is the joining together of many small molecules.
- it is the thermal decomposition of plastics
- it is carried out using saturated molecules
- it is a multiplication reaction

- Which of these is an addition polymer?
- styrene
- ethene
- p.v.c.
- propane

- How might you test to see if polystyrene still
- contained some unsaturated monomer (styrene)?
- Crush it up and burn it.
- Crush it up and add it to bromine water
- Crush it up and dissolve it in petrol
- Crush it up and add hydrochloric acid