

## Things to remember in the last hour before the exam: Level 1 Carbon

(This is not a revision sheet – you've done that by now – it's a list of things you might want to remind yourself about ...)

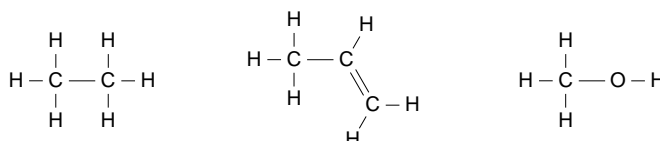
### 1. Names:

- Alkanes:  $C_nH_{2n+2}$ . methane. ethane. propane. butane. pentane. hexane. heptane. octane
- Alkenes:  $C_nH_{2n}$ . ethene. propene
- Alcohols:  $C_nH_{2n+1}OH$ : methanol. ethanol

### 2. Hydrocarbons – molecules that contain H and C atoms ONLY.

### 3. Saturated molecules – only have C-C single bonds. Unsaturated molecules – have a C=C double bond.

### 4. Structural formula – shows what atom is bonded to what. Remember C ALWAYS has 4 bonds! E.g.



### 5. A line between atoms is a covalent bond, which is a shared pair of electrons.



E.g. methane

ethene

### 6. Solubility in water. Alkanes and alkenes are insoluble in water e.g. hexane + water makes 2 immiscible layers. Immiscible means "doesn't mix". Methanol and ethanol are both fully soluble in water.

### 7. Melting (s → l) and boiling (l → g) points. As the number of C atoms increase in a molecule, their melting and boiling points increase. Bigger heavier molecules have strong forces of attraction between each other and so it takes more energy to separate them.

### 8. Combustion – burning.

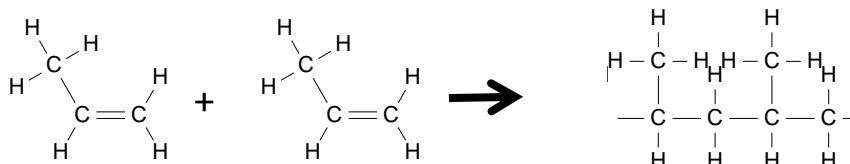
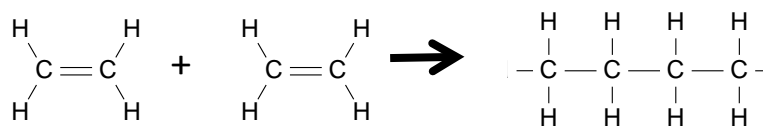
- Complete: needs plentiful  $O_2$  / good ventilation. Burns with clean / blue flame. Products  $CO_2$  and  $H_2O$ . Energy efficient – maximum amount of energy in hydrocarbon is released.
- Incomplete: occurs in limited  $O_2$  / poor ventilation. Burns with dirty yellow/orange flame. Products CO and C (soot) and  $H_2O$ . Reduced energy efficiency – less than maximum amount of energy in hydrocarbon is released.
- As C chain length increases you get more incomplete combustion occurring as bigger molecules need more  $O_2$  for complete combustion.  $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$  but...  $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

### 9. Effects of combustion products

- Increased levels of  $CO_2$  linked to enhanced greenhouse effect and global warming leading to climate change – melting polar ice & less settled weather, different climates affecting animals and plants etc.
- CO – colourless, odourless, toxic gas – stops haemoglobin in red blood cells carrying oxygen around body – so person suffocates.
- C – soot; dirty & polluting. Carbon particles can cause asthma in some people and even lung cancer.

### 10. Polymerisation. Monomers with C=C join together to form polymer with C-C bond. The process needs heat, high pressure and a catalyst to occur.

The double bond between each carbon atom in the alkene molecule is broken and a single covalent bond formed between these carbon atoms and carbon atoms of neighbouring molecules, forming long carbon chains



## 11. Fractional distillation of crude oil

- Crude oil is a mixture of hydrocarbons
- Separation is based on fact that different sized hydrocarbons have different boiling points – small molecules = low b.pt. big molecules = high b.pt. The bigger the molecules the stronger they are attracted to each other. Bigger molecules are therefore harder to vaporise.
- Chemical structure means SIZE / LENGTH of the molecule. The physical property that depends on the SIZE / LENGTH is the BOILING POINT of the molecule.
- Fractionating column
  - Hottest at bottom, large molecules condense here as have highest boiling points
  - Cooler as you go up, smaller molecules condense higher up as they have lower boiling points
  - Coolest at the top, gases (C1-4) collected at top – they have the lowest boiling points which is why they don't condense (stay as gases).

12. Cracking. Process using heat and/or catalyst to break long less useful alkanes e.g. naphtha fraction, into smaller more useful ones e.g. to make petrol or to make ethene (that can be made into plastics).

13. Fermentation. Anaerobic respiration. Enzymes in yeast turn sugar solution (e.g. glucose) into ethanol and carbon dioxide (in absence of oxygen).  $\text{C}_6\text{H}_{12}\text{O}_6 \rightarrow 2\text{C}_2\text{H}_5\text{OH} + 2\text{CO}_2$ .

14. Methanol from natural gas. Three step process. (1) steam reforming where methane reacts with steam  $\text{CH}_4 + \text{H}_2\text{O} \rightarrow \text{CO} + 3\text{H}_2$  (2) Water shift reaction – a reaction that adjusts the ratio of CO : H<sub>2</sub> gas, and (3) Synthesis reaction  $2\text{H}_2 + \text{CO} \rightarrow \text{CH}_3\text{OH}$ . Methanol is used to make other chemicals that are used in making paints, plastics & explosives, and in methylated spirits.

## 15. Uses of hydrocarbons and alcohols

- The major use of the alkanes is as fuels
- The alkenes are used to make polymers. You should discuss HOW the chemical properties (low chemical reactivity with air, water and many chemicals) and their physical properties (e.g. density, strength, ability to be melted and shaped, insoluble in water, thermal and electrical insulators etc.) are related to their use.
  - Polyethene – plastic bags and bottles
  - Polypropene – buckets, pipes and ropes (in water), polypropene fibres for clothing
- The alcohols are used as solvents, and fuels and ethanol is also used as a drink.