Reactions

Alkanes

Complete Combustion: alkane + oxygen ⟶ carbon dioxide + water
Incomplete combustion: alkane + oxygen ⟶ carbon monoxide + water
alkane + oxygen ⟶ carbon + water

Free radical substitution

- initiated by high energy UV light
- **homolytic fission** - covalent bond breaks, one electron from the bond pair goes on each of the previously bonded carbon atoms, producing two radicals
- **free radical** - very reactive particle with unpaired electrons
- further substitutions can occur - di/tri/tetra - limit with excess
- long chains = substitution at different positions

Alkenes

Hydrogenation: alkene + H_2 ⟶ alkane (nickel catalyst, 423K)
Halogenation: alkene + halogen ⟶ haloalkane
Addition of H halides: alkene + hydrogen halide ⟶ haloalkane
hydration: alkene + H_2O (steam) ⟶ alcohol (phosphoric acid catalyst, 60-770 atm and 573K

Electrophilic Addition

- double bond = region of high electron density, attract electrophiles
- **heterolytic fission** - covalent bond breaks, both electrons in the bond go to one atom, ions are formed
- **electrophile** - electron pair acceptors, attracted to electron rich regions, carry a full or slight positive charge
- **Markownikoff's Rule:** hydrogen halide added to unsymmetrical alkene = H attach to C with most H atoms and less C atoms attached to form the major product - most stable
- 3° Carbocations most stable - alkyl groups donate electrons towards +charge on carbocation - more alkyl groups is more stable

Alcohols

Combustion: alcohol + oxygen ⟶ carbon dioxide + water
dehydration: alcohol ⟶ alkene + water (reflux, conc. sulphuric or phosphoric acid catalyst)
substitution: alcohol + hydrogen halide ⟶ haloalkane (reflux with sulphuric acid + sodium halide)

Oxidation

- **Primary** + $K_2Cr_2O_7$ + H_2SO_4 + distillation + gentle heat ⟶ aldehyde green
- **Primary** + excess $K_2Cr_2O_7$ + H_2SO_4 + reflux + strong heat ⟶ carboxylic acid green
- **Secondary** + $K_2Cr_2O_7$ + H_2SO_4 + reflux + heat ⟶ ketone green
- **Tertiary:** not oxidised - no C-H bonds to break and C-C bonds too strong - remains orange

primary——**DISTILL**——aldehyde—— **REFLUX**——-carboxylic acids
secondary————**REFLUX**————ketone