AS91165

Demonstrate understanding of the properties of selected organic compounds

Alkanes	
Substitution reactions of alkanes with halogens (limited to monosubstitution)	
$CH_3CH_3 + Br_2 \rightarrow CH_3CH_2Br + HBr$ Similar reaction with Cl_2	Halogenation Need UV light and/or heat Swaps a H for a Br atom: Makes 2 products Orange colour of bromine is very slowly decolourised
Combustion – burning!! Needs O_2 (also oxidation reaction)	
$CH_3CH_3 + 3½O_2 \rightarrow 2CO_2 + 3H_2O$ Or $2CH_3CH_3 + 7O_2 \rightarrow 4CO_2 + 6H_2O$	• Plentiful O_2 needed for complete combustion; clean flame Products $H_2O + CO_2$ + maximum energy released Hint. Balance in order C H O….. • Limited O_2 get incomplete combustion; yellow and sooty flame Products $H_2O + C + CO$ + less energy released

Alkenes	
Addition reactions of alkenes with	
$CH_2=CH_2 + H_2 \rightarrow CH_3CH_3$	H_2/Pt catalyst and heat (Or Ni catalyst and heat) Also known as hydrogenation Turns C=C into C-C; one product
$CH_2=CH_2 + Br_2 \rightarrow CH_2BrCH_2Br$ Similar addition reaction with Cl_2 but colour change hard to see	Halogenation; Turns C=C into C-C; one product Orange colour of bromine is rapidly decolourised – very good test for C=C / unsaturation – no need for heat.
$CH_2=CH_2 + H_2O \rightarrow CH_3CH_2OH$	H_2O/H^+, heat (conc. H_2SO_4/H_2O, heat) – hydration Makes an alcohol! Turns C=C into C-C; one product
$CH_2=CH_2 + HCl \rightarrow CH_3CH_2Cl$	Hydrohalogenation, reaction with hydrogen halides. HBr has a similar reaction. Turns C=C into C-C; one product Don't forget identification of major and minor products on addition to asymmetric alkenes – the rich get richer.
$n\ CH_2=CH_2 \rightarrow -(CH_2CH_2)-_n$	Polymerisation; needs heat + catalyst + pressure Makes a long (unreactive) saturated molecule with C-C bonds Monomer → polymer. Usually draw 3 repeating units. Hint: for propene draw as  and draw as "polyethene" with one CH_3- on every other C atom in place of an H.
Oxidation of alkenes	
$CH_2=CH_2 + H_2O + [O] \rightarrow CH_2OHCH_2OH$ The $H_2O + [O]$ represents the solution of oxidising agent, MnO_4^- but we don't write the MnO_4^- in the equation	Does **NOT** need heat Shake with MnO_4^-; colour change purple to brown Shake with H^+/ MnO_4^-; colour change purple to colourless Makes a DIOL; 2 x OH groups added across double bond. Just learn it & remember it is OXIDATION reaction, not addition.
$CH_2=CH_2 + 3O_2 \rightarrow 2CO_2 + 2H_2O$	Combustion is also an oxidation reaction but we don't burn alkenes as they are too useful e.g. for making into plastics. Of course it can be complete or incomplete depending on how much O_2 there is; tends to be incomplete especially as # of C↑.

Alkynes	
Addition reactions of alkynes with	
$CH{\equiv}CH + 2Br_2 \rightarrow CHBr_2CHBr_2$	C≡C to C-C; one product Orange colour of bromine is rapidly decolourised – very good test for unsaturation

Haloalkanes	
Substitution reactions of haloalkanes	
$CH_3CH_2Cl + NH_3 \rightarrow CH_3CH_2NH_2 + HCl$	Heat with conc. ammonia
$CH_3CH_2Cl + KOH \rightarrow CH_3CH_2OH + KCl$	Heat with *aqueous* potassium hydroxide – written KOH(aq)
Elimination reactions of haloalkanes	
$CH_3CH_2Cl + KOH \rightarrow CH_2{=}CH_2 + KCl + H_2O$	Heat with *alcoholic* potassium hydroxide – written KOH(alc) or KOH (Et) (including identification of major and minor products for asymmetric reactants). Creates an alkene with C=C (unsaturated).

Primary amines	
Acid–base reactions of amines	
$CH_3CH_2NH_2 + H_2O \rightleftharpoons CH_3CH_2NH_3^+ + OH^-$	React with water to produce the OH^- ion that makes the solution (weakly) alkaline; identify with litmus or UI.
$CH_3CH_2NH_2 + CH_3COOH \rightleftharpoons CH_3COO^- \ {}^+H_3NCH_2CH_3$	This is a salt (proton transfer) – no need to name!!

Alcohols	
Substitution reactions of alcohols	
"$CH_3CH_2OH \rightarrow CH_3CH_2Cl$"	With hydrogen halides, PCl_3, PCl_5, $SOCl_2$ All swap OH group for Cl atom. $SOCl_2$ is the best one!! ☺
Oxidation of primary alcohols	
"$CH_3CH_2OH \rightarrow CH_3COOH$" $C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$	To form carboxylic acids with MnO_4^-/H^+, heat (purple MnO_4^- turns to colourless Mn^{2+}) or $Cr_2O_7^{2-}/H^+$, heat (orange $Cr_2O_7^{2-}$ turns to green Cr^{3+}) Also combustion (also oxidation reaction) as alcohols make good fuels, burning cleanly (complete combustion).
Elimination from alcohols	
$CH_3CH_2OH \rightarrow CH_2{=}CH_2 + H_2O$	elimination of (including identification of major and minor products for asymmetric reactants) water from alcohols Also knows as dehydration Conc. H_2SO_4 or conc. H_3PO_4, heat

Carboxylic acids	
Acid–base reactions ("base" could include hydroxide and carbonate and hydrogen carbonate!!)	
$CH_3COOH + H_2O \rightleftharpoons CH_3COO^- + H_3O^+$	Weak acids (pH 3-5); identify with litmus or UI.
$CH_3COOH + NaOH \longrightarrow CH_3COONa^* + H_2O$	Acid + base → salt + water
$2CH_3COOH + Na_2CO_3 \longrightarrow 2CH_3COONa^* + H_2O + CO_2$	Acid + carbonate → salt + water + carbon dioxide
$CH_3COOH + NaHCO_3 \longrightarrow CH_3COONa^* + H_2O + CO_2$	Acid + hydrogen carbonate → salt + water + carbon dioxide
	*Write the sodium salt as RCOONa or $RCOO^-Na^+$
$2CH_3COOH + Mg \longrightarrow (CH_3COO)_2Mg + H_2$	Carboxylic acids would also produce hydrogen gas with a reactive metal such as Mg