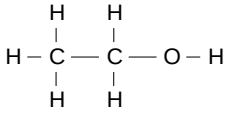
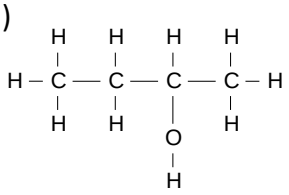
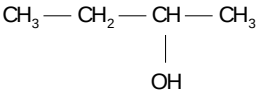
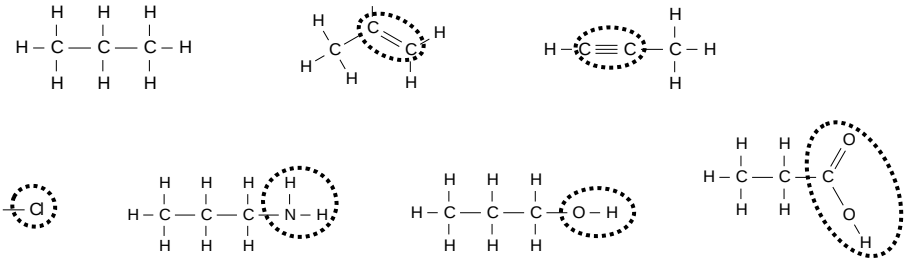
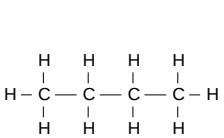
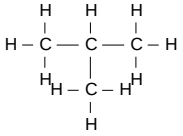
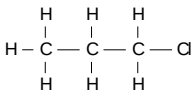
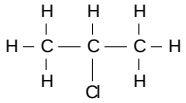
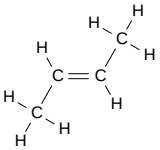
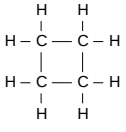
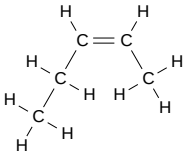
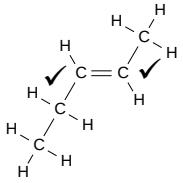
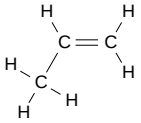
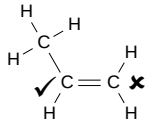
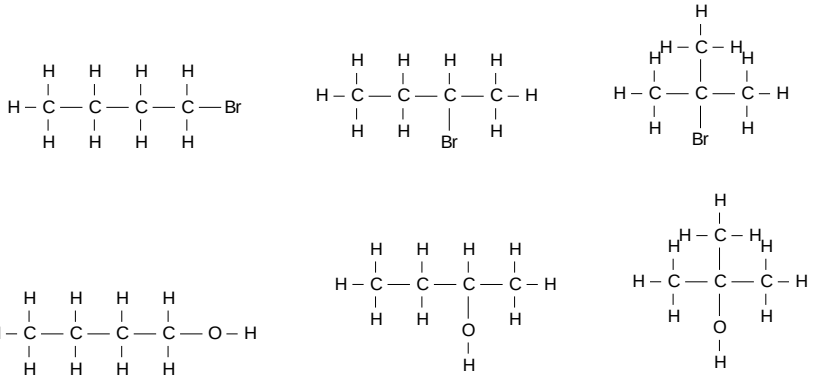
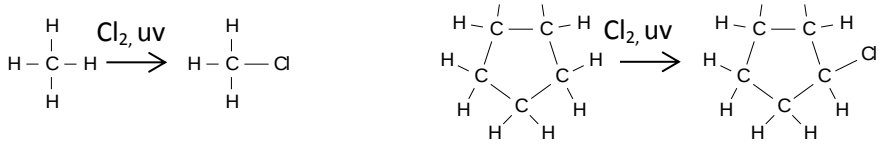
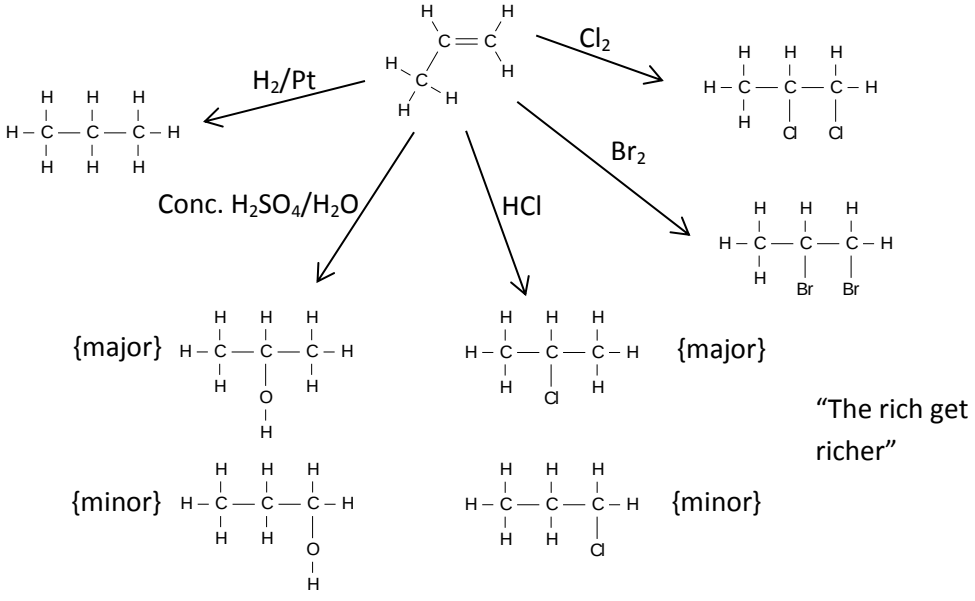
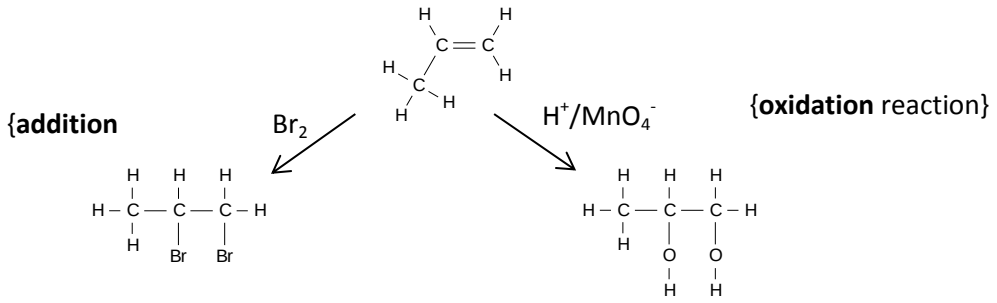
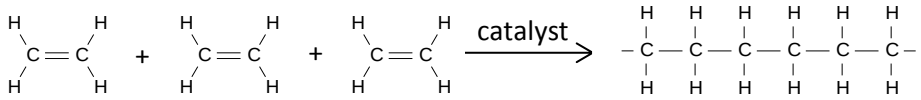
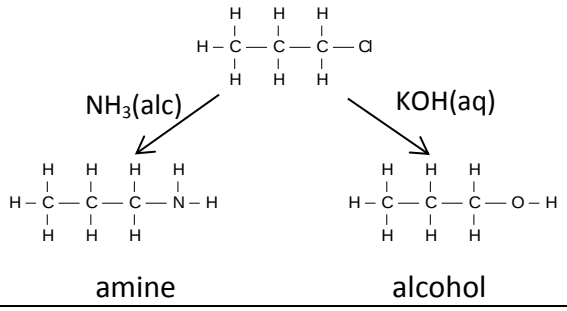
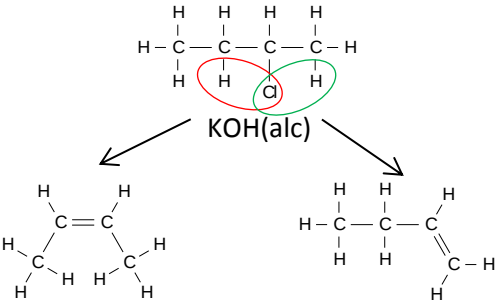
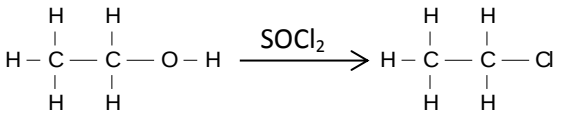
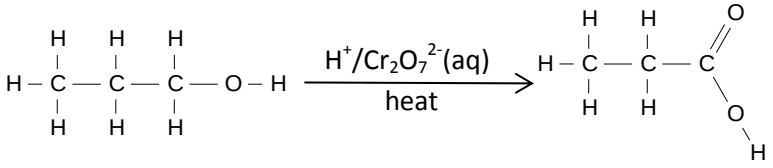
AS91165

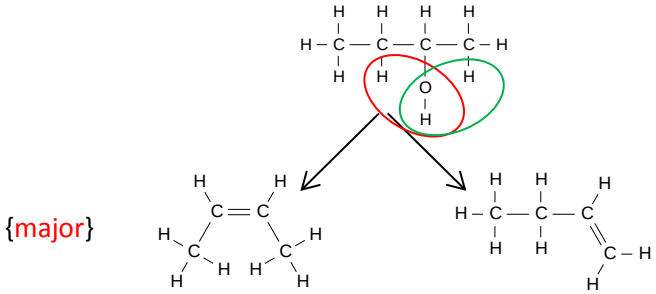
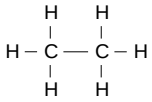
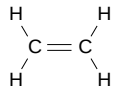
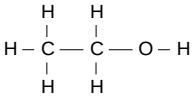
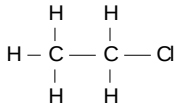
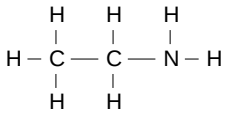
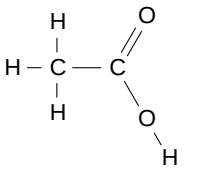
Demonstrate understanding of the properties of selected organic compounds

Level 2 4 Credits

Naming of organic molecules is done according to IUPAC convention 1 meth- 2 eth- 3 prop- 4 but- 5 pent- 6 hex-	At its simplest, the IUPAC name for an organic compound contains these two parts: a *root* indicating how many carbon atoms are in the longest continuous chain of carbon atoms AND a prefix and/or suffix to indicate the family to which the compound belongs. E.g. the name ethanol indicates a carbon chain of length two (eth-) and an OH functional group (-anol). 
Formulae	Empirical – simplest whole number ratio of atoms e.g. CH_2O Molecular – formula of actual molecule e.g. $C_3H_6O_3$
Equations should be written using either names or structural formulae. In writing structural formulae, students may use either the condensed or expanded forms.	(expanded)  <u>or</u> $CH_2CH_2CH(OH)CH_3$ (condensed) <u>or</u> 
Recognising selected functional groups (alkane, alkene, alkyne, haloalkane, amine, alcohol, carboxylic acid)	
Constitutional isomers. Identifying and drawing structural isomers – chain, position, functional group	 and  (different skeleton / chain)  and  (different position)  and  (different functional group)

Geometric isomers. Identifying cis-trans isomers and drawing their structural formulae – occur when there is C=C as there is no "free rotation" around C=C i.e. it can't twist.	To be cis/trans must have 2 different groups attached to each end of the double bond.  and  but not  and 
Classifying a haloalkane or an alcohol as primary, secondary or tertiary	
Drawing a product of halogenation of alkanes (limited to mono-**substitution**) Cl_2 or Br_2, uv light. (HCl(g) also produced)	
Drawing the products of **addition reactions** of alkenes of up to 8 carbon atoms with • H_2/Pt (hydrogenation) • Cl_2 (chlorination) • Br_2 (bromination) • Conc. H_2SO_4/H_2O (hydration) HCl or HBr (hydrohalogenation) Identification of major and minor products on addition to asymmetric alkenes.	

Identifying alkenes using observations of reaction with Br_2 and H^+/MnO_4^-. Br_2 water turns from orange to colourless MnO_4^-(aq) from purple to brown ppt. BUT H^+/MnO_4^-(aq) from purple to colourless.	
Addition polymerisation of alkenes	
Substitution reactions of haloalkanes with ammonia NH_3(alc) and potassium hydroxide KOH(aq)	
Elimination reactions of haloalkanes with KOH (alc). Identification of major and minor products of asymmetric reactants.	"The poor get poorer"  (KCl & H_2O also formed).
Acid-base reactions of primary amines	Compare with NH_3 (ammonia) ; turn red litmus paper blue, turn green UI paper blue-purple $NH_3 + HCl \rightarrow NH_4^+Cl^-$ (ammonium chloride) $CH_3CH_2NH_2 + HCl \rightarrow CH_3CH_2NH_3^+Cl^-$
Substitution reactions of alcohols With PCl_3, PCl_5 & $SOCl_2$	The - OH group of alcohol is replaced by - Cl to form a haloalkane 
Oxidation of primary alcohols to form carboxylic acids • H^+/MnO_4^-(aq),heat • $H^+/Cr_2O_7^{2-}$(aq), heat	

<table>
<tr><td>Dehydration of alcohols (<u>elimination</u> of water) with conc. sulfuric acid H_2SO_4. (Or conc. phosphoric acid, H_3PO_4).
Identification of major and minor products.</td><td colspan="3"> 
{major} {minor}
"The poor get poorer"</td></tr>
<tr><td>Identifying carboxylic acids using their acidic properties</td><td colspan="3">Turn blue litmus paper RED. Turn UI paper ORANGE.
+ Mg, produce H_2 gas. E.g. $2CH_3COOH + Mg \rightarrow Mg(CH_3COO)_2 + H_2$
+ carbonate or hydrogen carbonate, produce CO_2 gas. E.g. $CH_3COOH + NaHCO_3 \rightarrow NaCH_3COO + H_2O + CO_2$ ($NaCH_3COO$ a.k.a CH_3COONa, sodium ethanoate)
May have a sharp (vinegary) smell, larger C. acids FOUL smelling!!</td></tr>
<tr><td rowspan="3">Distinguishing between different functional groups using experimental observations.
 
 
 
 
 
 
  </td><td><u>Alkanes</u>
C1-4 are gases, C5-15 liquids, C16 upwards solids @ room temperature
• insoluble in water
• slowly decolourise Br_2 or Br_2 water in presence of UV light (or 200-450^oC)</td><td><u>Alkenes</u>
• insoluble in water
• rapidly decolourise Br_2 or Br_2 water
• burn with smokier / sootier flame that the alkane</td><td><u>Alkynes</u>
• insoluble in water
• rapidly decolourise Br_2 or Br_2 water
• burn with smokier / sootier flame that the alkene</td></tr>
<tr><td><u>Alcohols</u>
• have higher boiling points than the corresponding alkanes (due to attraction between polar OH group on neighboring alcohols).
• C1-3 soluble in water, ≥ C4 insoluble.
• primary alcohols are oxidised to carboxylic acids by warming with $H^+/Cr_2O_7^{2-}$. Orange $Cr_2O_7^{2-}$ is reduced to green Cr^{3+}.
• react with $SOCl_2$ to make haloalkane.</td><td><u>Haloalkanes</u>
• CH_3Cl, CH_3Br, C_2H_5Cl are all gases at room temperature and pressure.
• the other haloalkanes are liquids
• they are all immiscible with water (insoluble, form 2 layers)
• react to form alcohols (substitution reaction) with KOH(aq) or alkenes (elimination reaction) with KOH (alc)</td><td><u>Amines</u>
• CH_3NH_2 is a gas, others are liquids at room temperature
• Small amines are very soluble in water but as C↑ their solubility ↓
• Unpleasant fishy smell, or rotting smell
• Are weak bases; turn red litmus blue and green UI paper blue-purple</td></tr>
<tr><td colspan="3"><u>Carboxylic acids</u>
• have higher boiling points than the corresponding alcohols (due to attraction between polar -COOH group on neighbouring acids).
• C1-3 soluble in water, ≥ C4 insoluble.
• React with reactive metals like Mg or Zn → H_2 gas, with carbonates and
• hydrogen carbonates → CO_2 gas, turn blue litmus → RED and turns Universal
• Indicator → ORANGE</td></tr>
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