SL & HL Answers to Halogenoalkanes & benzene questions

1. $CH_3CH_2CH_2Br + NaOH \rightarrow CH_3CH_2CH_2OH + NaBr$ (*organic product*: propan-1-ol)

2. i. *Homolytic fission*: when a bond breaks one of the electrons in the bond goes to one of the atoms and the other electron goes to the other atom which formed the bond to produce free radicals.
Heterolytic fission: both of the electrons in the pair forming the bond go to one of the atoms and not to the other atom forming positive and negative ions.

ii. *Homolytic fission*: Free radical substitution with chlorine gas.
Heterolytic fission: Nucleophilic substitution with sodium hydroxide.

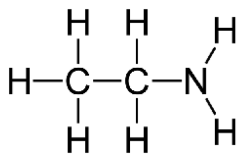
iii. $CH_3Cl + Cl_2 \rightarrow CH_2Cl_2 + HCl$
Conditions: ultraviolet light.
$CH_3Cl + NaOH \rightarrow CH_3OH + NaCl$
Conditions: warm, dilute aqueous sodium hydroxide solution.

3. i. A nucleophile, such as the hydroxide ion, is an electron-rich species (small molecule or ion) that contains at least one non-bonding pair of electrons that it donates to an electron-deficient carbon.

ii. Bromine is more electronegative than carbon so the C−Br bond is polar with the δ^+ on the carbon atom making it attracted to nucleophiles.

iii. Both ammonia and cyanide ions contain a lone pair (non-bonding pair) of electrons that can be donated to an electron-deficient carbon atom.

iv.



class of compound: Amine

4. i. $C_6H_{10} + Br_2 \rightarrow C_6H_{10}Br_2$ *Name of product:* 1,2-dibromocyclohexane
(Note that if bromine water is used the main product will actually be $C_6H_{10}(OH)Br$, 2-bromocyclohexanol not 1,2-dibromocyclohexane)

ii. $C_6H_6 + Br_2 \rightarrow C_6H_5Br + HBr$ *Name of organic product:* Bromobenzene

iii. Because of the resonance structures the benzene ring has extra stability (of approximately 150 kJ mol^{-1}) which has to be overcome if an addition reaction occurs. This is not the case if substitution occurs as the resonance structure (delocalization) of the phenyl ring is not destroyed.