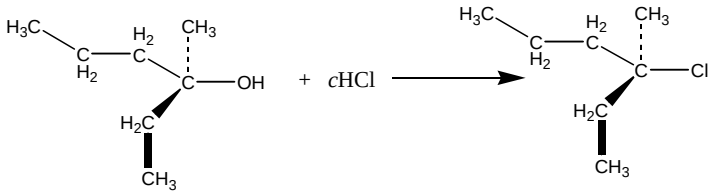
CH1012 Tutorial 9 Answers

1. Predict (skeletal structure) and **name the product** from each of the following reactions:
   Give the **name of the reaction type**. (N.B. Me = CH_3, Et = C_2H_5)
   .

   (i) $MeC{\equiv}CEt + 2Br_2 \rightarrow MeBr_2C\text{-}CBr_2Et$ 2,2,3,3-tetrabromopentane
   electrophilic addition – bromination

   (ii)



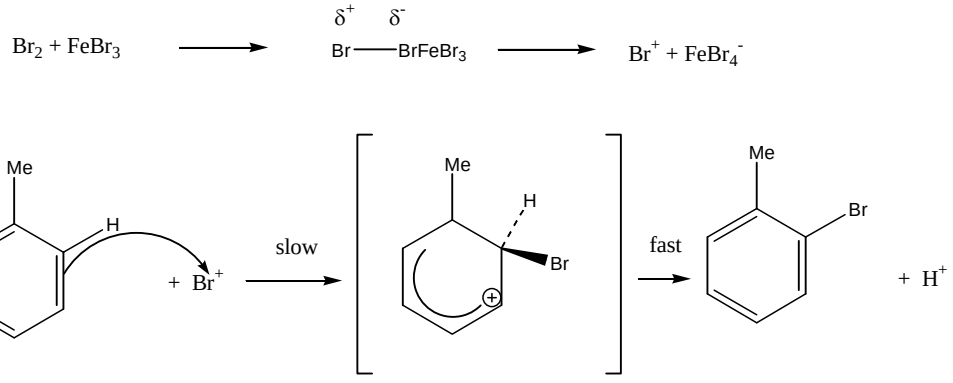
   R & S forms racemic
   Nucleophilic substitution S_N1
   3-chloro-3-methylhexane

   (iii) $CH_3CH_2CH{=}CH_2 + HCl \rightarrow CH_3CH_2CHClCH_3$
   electrophilic addition – Markovnikov directed
   2-chlorobutane

2. Explain why **aromatic compounds** react with bromine in the presence of a Lewis acid to give **substitution** rather than addition products.

   The reaction of electrophilic reagents such as the bromine ion to give substitution products occurs as this pathway is exothermic whereas the addition pathway is endothermic.

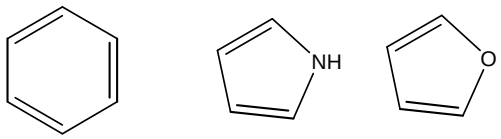
   Illustrate your answer using toluene (MeC_6H_5) and Br_2 / $FeBr_3$.



Potential energy diagram should also be drawn illustrating that the addition reaction is more endothermic that the E.A.S. reaction.

3. Aromatic compounds must obey the **(4n +2) π electron rule** what does this mean?

   The special stability of aromatic compounds results from the delocalisation of the pi electrons around the planar ring system. When the number of electrons able to form a pi system is (4n +2) then a stable



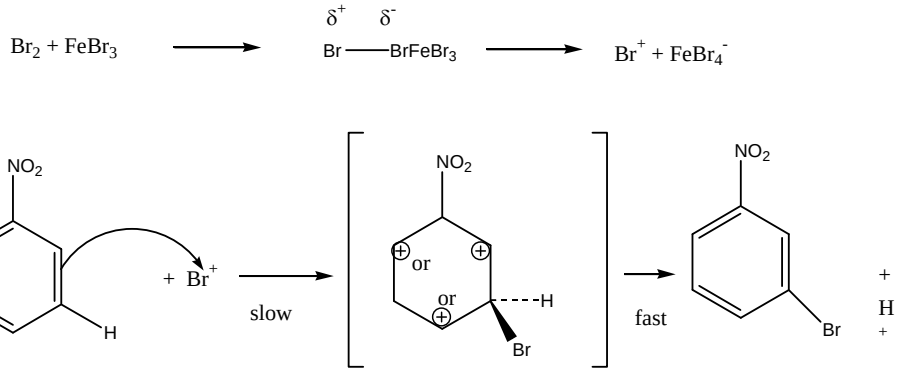
aromatic system is formed. Resonance stabilisation is not obtained with other electron counts.

Give some simple examples to illustrate your answer.

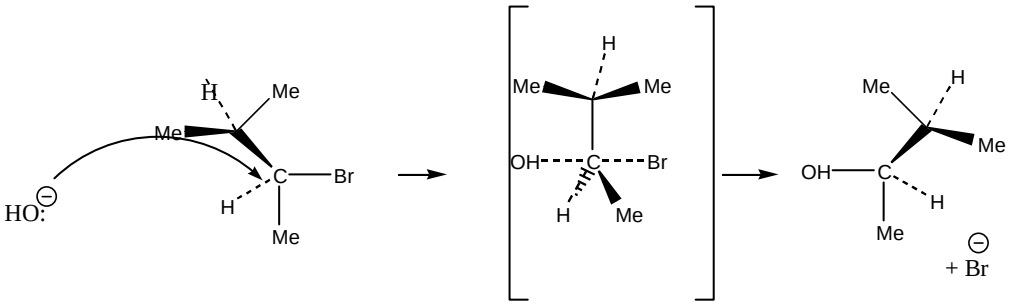
Benzene 6 x sp^2 carbons therefore 6 pi electrons.
Pyrrole 4 x sp^2 carbons 4 electrons, 1 x N sp^2 carbon 2 electrons, total 6 pi electrons.
Furan 4 x sp^2 carbons 4 electrons, 1 x O sp^2 2 electrons out of plane, total 6 pi electrons.

4. Describe in detail the mechanism for the following reactions using a simple example for each:

(i) **meta directed electrophilic aromatic substitution**



(ii) **S_N2** reaction of 2-bromo-3-methylbutane with sodium hydroxide. Indicate the **stereochemistry** of the reactant and product and **name** the product.



S (*R*)-3-methyl-2-butanol