

Chemguide – questions

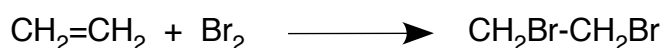
BONDING IN BENZENE

1. Models of benzene frequently look something like this, showing a delocalised pi orbital above and below the plane of the molecule:

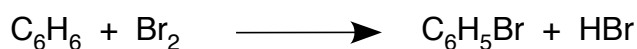


- a) Write the electronic structure of a carbon atom in its ground (unexcited) state.
- b) The six carbon atoms each promote an electron and then hybridise before bonding. Describe, in words and with diagrams where appropriate, what happens during these processes.
- c) Describe in words what happens when the hybridised atoms form bonds with each other and with the hydrogen atoms.
- d) The commonly used diagram above shows a delocalised pi orbital. Explain why that is misleading.
2. The more you can delocalise electrons (spread them over several atoms), the more energetically stable a structure becomes. The delocalisation that happens in benzene makes it about 150 kJ mol^{-1} more stable than it would be if delocalisation hadn't happened.

Ethene and benzene react with bromine in quite different ways. With ethene, bromine reacts with an addition reaction:



With benzene, you get a substitution reaction in which one of the hydrogen atoms is replaced by a bromine:



Why does benzene tend to undergo substitution reactions rather than addition reactions?