

## Tutorials Catalysis – Heterogeneous Catalysis

1. Alkanes form stable physisorbed assemblies at a flat graphite or gold surface.
  - (a) Explain why such a physisorption process is thermodynamically favourable (include the roles of enthalpy and entropy in your answer).
  - (b) Explain why the alkanes nearly always tend to form a close-packed structure at the surface.
2. Why is a relatively low temperature favourable for catalysis of ammonia formation in the Haber Bosch process?
3. The ZSM-5 zeolite catalyzes the isomerization of 1,3-dimethylbenzene into 1,4-dimethylbenzene. Write out a mechanism for this catalytic reaction.
4. Provide explanations why the Haber-Bosch process of ammonia synthesis makes use of **Fe** or **Ru** as catalysts and not **Ag** or **Cr**.
5. Why does CO bind relatively strongly on metals such as **Ni**, **Pd**, and **Pt**, but not on **Cu**, **Ag**, and **Au**?
6. Consider the oxidation on a Pt surface of CO by O<sub>2</sub> to give CO<sub>2</sub>, which happens in an automotive catalyst. Write down a plausible reaction mechanism for this catalytic process, and predict and motivate what will be the rate-determining step