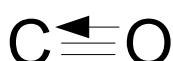


## Chemguide – questions

### CO-ORDINATE (DATIVE COVALENT) BONDING

You may need a copy of the Periodic Table.

1. What is a co-ordinate (or dative covalent) bond?
2. Carbon monoxide can be represented as:



Redraw this using a dots-and-crosses diagram to make clear the difference between the bond shown by the arrow and those shown by the ordinary lines.

3. a) The ammonium ion,  $\text{NH}_4^+$ , and the hydroxonium ion,  $\text{H}_3\text{O}^+$ , contain ordinary covalent bonds and co-ordinate bonds. Draw dots-and-crosses diagrams to show the bonding in both of these ions, making clear which sort of bond is which.  
b) Draw a dots-and-crosses diagram for the ion  $\text{H}_2\text{F}^+$ . (This isn't mentioned anywhere on the Chemguide page you will have just read. You will need to work it out for yourself.)
4. a) Aluminium chloride sublimes (turns directly from a solid to a gas) at about  $180^\circ\text{C}$ . Measurements of its relative molecular mass show that its formula is  $\text{Al}_2\text{Cl}_6$  in the vapour at that temperature. Draw a dots-and-crosses diagram (showing outer electrons only) to show how the aluminium chloride is bonded in  $\text{Al}_2\text{Cl}_6$ .  
b) Ammonia,  $\text{NH}_3$ , and boron trifluoride,  $\text{BF}_3$ , combine to make a compound  $\text{NH}_3\cdot\text{BF}_3$ . Draw a dots-and-crosses diagram (showing outer electrons only) to show the bonding in this new compound.
5. Most metal ions in solution react with water to give what are called *hydrated ions*. For example, magnesium ions in solution exist as  $[\text{Mg}(\text{H}_2\text{O})_6]^{2+}$ . The water molecules attach to the magnesium ions via co-ordinate bonds.
  - a) Explain what it is about water that enables it to form co-ordinate bonds.
  - b) The electronic structure of magnesium is  $1s^2 2s^2 2p^6 3s^2$ . What is the electronic structure of a magnesium ion,  $\text{Mg}^{2+}$ ?
  - c) Explain briefly which orbitals are used in the magnesium ion for attaching the water molecules to.
  - d) (You will have to think about this one!) Beryllium is in the same group as magnesium, but unlike the rest of Group 2 forms a hydrated ion with only four water molecules attached. Can you think of a reason (or perhaps two reasons) why that might be?