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, NH_4^+, and the hydroxonium ion, H_3O^+, 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 H_2F^+. (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°C. Measurements of its relative molecular mass show that its formula is Al_2Cl_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 Al_2Cl_6.

   b) Ammonia, NH_3, and boron trifluoride, BF_3, combine to make a compound $NH_3.BF_3$. 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 $[Mg(H_2O)_6]^{2+}$. 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, 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?