COVALENT BONDING (single bonds)

You will need a copy of the Periodic Table for some questions.

1. A covalent bond consists of a pair of shared electrons between two atoms. How does this shared pair hold the two atoms together?

2. Draw dots-and-crosses diagrams (showing outer electrons only) for the following covalent compounds.

   a) ammonia, NH_3

   b) hydrogen sulphide, H_2S

   c) hydrogen iodide, HI

   d) nitrogen trichloride, NCl_3

   e) boron trifluoride, BF_3

The rest of the questions go beyond what you are likely to be asked for most UK-based syllabuses, but you should try them anyway, even if your syllabus says that you don't need to know about hybridisation. It isn't difficult, and will help your understanding of future topics.

If you go on using Chemguide you will find hybridisation discussed several times, particularly in organic chemistry, because there is no other way of making sense of the structures of important substances like ethene and benzene

In question 3, I want to guide you through the structure of methane, CH_4, using a more modern view of covalent bonding. Then in question 4, you will use the same process to explain the bonding in some more complex molecules.

3. Carbon has the electronic structure $1s^2\ 2s^2\ 2p_x^1\ 2p_y^1$. Thinking about the bonding in methane:

   a) The first step is promotion of an electron to give 4 unpaired electrons. Show this happening, in some combination of words and diagrams as you prefer.

   b) The second step is hybridisation. Explain what this means, and what the result of it is.

   c) The final step is the formation of molecular orbitals involving carbon's orbitals and four hydrogen atoms. Describe what happens at this stage.

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4. By going through the same sort of process as you did in question 4, explain how the covalent bonding in the following compounds arises. In each case, you need only explain what happens to the central atom (the P, S or Xe).

   You can finish each explanation in the same way that I have done with PCl_5 on the Chemguide page. For example, in the PCl_5 case : "The electrons in each of these orbitals would then share space with electrons from five chlorines to make five new molecular orbitals - and hence five covalent bonds."

   a) PCl_5

   b) SF_6

   c) XeF_4

5. Something for you to think about – re-reading the Chemguide page won't help!

   The noble gas xenon forms several compounds (usually involving oxygen or fluorine), but neon, which is also a noble gas, doesn't form compounds. Can you suggest why that might be? Why couldn't Ne form NeF_4 in a similar way to XeF_4?