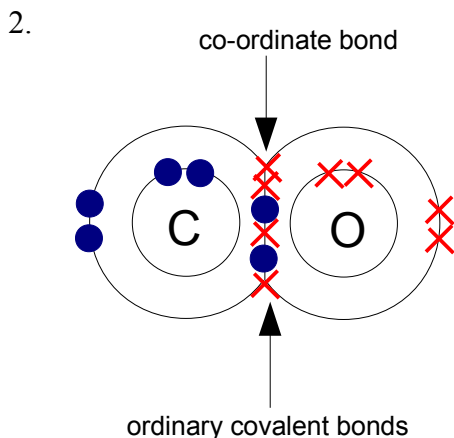


## Chemguide – answers

### CO-ORDINATE (DATIVE COVALENT) BONDING

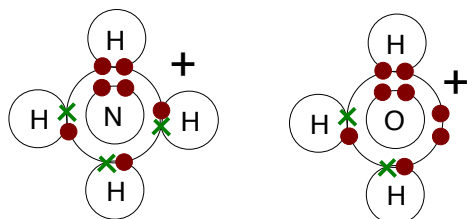
1. This is a covalent bond (a pair of shared electrons) in which both electrons came from the same atom.



The question didn't allow you to just draw the outer electrons! In that case, if you don't put all the electrons in, you risk losing a mark. You have to read the question carefully.

3. In the diagrams below, the bonds consisting of two red dots are the co-ordinate bonds. The ordinary covalent bonds have a dot and a cross.

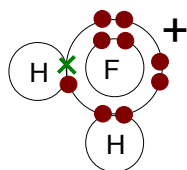
a)



In the first diagram, it doesn't matter which bond you show as the co-ordinate one.

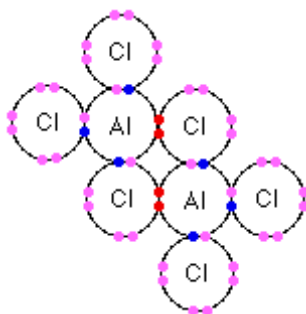
It doesn't matter where you attach the three hydrogens around the oxygen in the second diagram, as long as you show one co-ordinate and two simple covalent bonds.

b)



Again, it doesn't matter where you attach the two hydrogens around the fluorine, or which bond you show as the co-ordinate one.

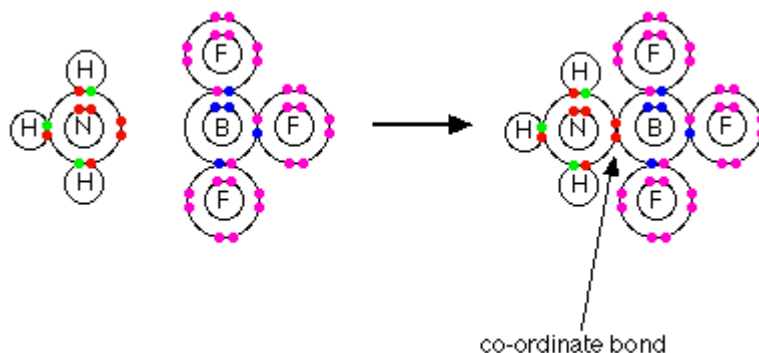
4. a)



This diagram is taken from the Chemguide page. It doesn't matter if you haven't colour-coded everything as long as it is obvious that the two bonds drawn here with red electrons are different from the other bonds.

## Chemguide – answers

b)



Again, this diagram comes from the Chemguide page. You only need the structure of the product, and you don't need to point out the co-ordinate bond, but it must be clear that both electrons in the bond are coming from the nitrogen. You don't need to draw the inner electrons.

5. a) The lone pairs of electrons on the oxygen atom.

b)  $1s^2 2s^2 2p^6$

c) If it is going to form six co-ordinate bonds, it will need six empty orbitals on the magnesium ion. These will be hybridised versions of the 3s, the three 3p orbitals and two of the 3d orbitals.

d) There are two things which you might have thought of.

One is that the beryllium ion is going to be very small (its electronic structure is just  $1s^2$ ), and so it may be impossible to fit six water molecules around it. But in fact that possibility can never arise anyway.

The main reason is that beryllium doesn't have enough orbitals of the right energy. There aren't any 2d orbitals – only the 2s and the three 2p orbitals, and it uses a hybridised version of these to join to the four water molecules. To fit six water molecules around it would need it to use 3-level orbitals as well. There is too big an energy gap between the 2- and 3-level orbitals for this to work.

Well done if you managed to get this answer!