ELECTRONEGATIVITY

1. Electronegativity is a measure of the tendency of an atom to attract a bonding pair of electrons.

2. a) In both cases, the bonding electrons are in the 2-level and screened from the nucleus by the 1s electrons. But oxygen has 8 protons in the nucleus whereas nitrogen only has 7. A bonding pair will experience more attraction from the oxygen's nucleus than from nitrogen's, and so the electronegativity of oxygen is greater.

   b) Sulphur's bonding electrons are in the 3-level and are shielded from the 16 protons in the nucleus by a total of 10 electrons in the 1- and 2-levels. The outer electrons therefore experience a net pull from the nucleus of 6+.

   With oxygen, the bonding electrons are at the 2-level, and the 8 protons in the nucleus are shielded by the 2 electrons in the 1s orbital. Again, there is a net pull of 6+ from the nucleus.

   However, the bonding electrons in the sulphur are further from the nucleus, and so the attraction is lessened. So sulphur is less electronegative than oxygen.

3. *lowest* caesium barium calcium aluminium boron carbon fluorine *biggest*

   If you got this wrong:

   Ignoring the noble gases, electronegativity increases towards the top right corner of the Periodic Table. The lowest value will therefore be in the bottom left – of these atoms, that's caesium.

   Electronegativity increases across a period. Barium is the next member of caesium's period, and so that will be second lowest. There is nothing else in that part of the Periodic Table in the list which you need to worry about.

   Electronegativity increases as you go up a group. Calcium is higher in the group than barium, so will have a higher electronegativity. Is its electronegativity higher than aluminium's?

   No. Aluminium's must be higher because it is further up the Periodic Table, and one group further to the right.

   Boron's electronegativity will be higher than aluminium's because it is higher in the group.

   After that, electronegativity will increase as you go across boron's period to carbon and then fluorine.

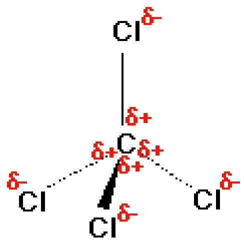
4. a) Cl_2 will have non-polar bonds because the bond has identical atoms at each end. The electron pair will be on average held half-way between the two. There is no net pull one way or the other.

b) CsCl. Caesium has the lowest electronegativity of any of the atoms in the list joined to one or more chlorine atoms. There will therefore be the greatest electronegativity difference when caesium joins to chlorine than in any other case in the list. The greater the electronegativity difference, the more the electron pair will be pulled to one end of the bond, and the more ionic the compound is.

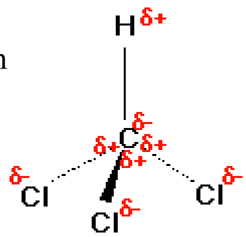
c) You could suggest one of two possibilities - PCl_3 or SCl_2. In a polar covalent bond, there isn't enough electronegativity difference to form ions, and so you are looking for an example with a small electronegativity difference. Remember that electronegativity increases across a period, and so it would be safest to choose an example of the other atom being as close as possible to chlorine in the period. That means that your safest choice would be SCl_2. In fact, PCl_3 is also polar covalent, because there isn't enough electronegativity difference here either to make it ionic.

5. A polar bond is one between two atoms of different electronegativity. An electron pair will be pulled towards the more electronegative atom making that slightly negative. The atom at the other end of the bond will be left slightly positive.

For example, in CCl_4, all the bonds are polar because the chlorine is more electronegative than carbon.



This is also true in $CHCl_3$, except in this case one of the bonds is polarised the other way around, because carbon is more electronegative than hydrogen.



A polar molecule is one which has an overall charge separation – in the sense that one side or end of the molecule is slightly negative and the other slightly positive. That is the case in $CHCl_3$ where the top of the molecule (as drawn) is slightly positive, and the bottom slightly negative.

However, CCl_4 is a non-polar molecule even though it contains polar bonds. Although the outside of the molecule is slightly negative, it has the same negativeness in all directions. It doesn't have a positive side or end and a negative one.