**Case II:** All molecules with the central atom surrounded by 3 bonding pairs and one non bonding pair (lone pair) have a **triangular (or trigonal) pyramidal** **shape**. Due to the strong repulsion, a non bonding electron pair requires more space than a bonding pair, the angles in these molecules are 107 not 109.5. Examples: NH3, PH3



Where A represents the central atom and X represents outer atom.

**Case III:** All molecules with the central atom surrounded by two bonding pairs and two non bonding pairs have the **bent or v-shape.** The repulsion between the non bonding pairs with result in a bond angle of 104.5. EX: H2O, H2S,…



**Case IV:** All molecules with the central atom surrounded by 5 pairs of bonding pairs have a **trigonal bipyramidal** shape which consists of two pyramids sharing the same base.

**Examples:** PF5, PCl5 etc



**Case V:** Molecules with the central atom with an incomplete octet.

i) Molecules that only have 2 bonding pairs on the central atom will have a **linear** shape with a bond angle of 1800

 **Example:** BeCl2, BeH2, etc 

ii) Molecules that only have 2 bonding pairs on the central atom will have a **triangular planar** shape with a bond angle of 1200

 **Example:** BCl3, AlCl3 etc



 **Polarity of molecules**

A non-polar molecule has no net dipole. This can be achieved by the molecule having:

1. only [*non-polar bonds*](http://www.ausetute.com.au/bondpola.html)
2. [*polar bonds*](http://www.ausetute.com.au/bondpola.html)arranged symmetrically so that the dipoles cancel out

A polar molecule has a net dipole. This is achieved in the molecule by the molecule being made up of [*polar bonds*](http://www.ausetute.com.au/bondpola.html) arranged asymmetrically so that the dipoles do not cancel out (i.e There is no overall separation of charges).

**Examples**

1. **Non-polar Molecules**

**Case I: Only non-polar bonds present**

**H-H** is non-polar since both hydrogen atoms making up the molecule have equal electronegativity so there is no net dipole.

 **NCl3** is non-polar since the nitrogen atom and the chlorine atoms making up the molecule have the same electronegativity so there is no net dipole.

**Case II: Polar bonds arranged symmetrically**

**CO2** is non-polar**.** Each C - O bond is polar since oxygen is more electronegative than carbon, however, these bonds are arranged symmetrically (all angles are 180o) so that the two dipoles cancel out resulting in no net dipole for the molecule.

**AlCl3** is non-polar. Each Al-Cl bond is polar since chlorine is much more electronegative than aluminium, however, each Al-Cl bond in AlCl3 is arranged symmetrically (all angles are 120o) so that the dipoles cancel out resulting in no net dipole for the molecule.

**CH4** is non-polar. Each C-H bond is polar since carbon is more electronegative than hydrogen, however, each C-H bond in CH4 is arranged symmetrically (all angles are 109.5o) so that the dipoles cancel out resulting in no net dipole for the molecule.

1. **Polar Molecules**

**Polar bonds arranged asymmetrically** (i.e There is overall separation of charges)

**HCN** is polar. Both the C-H and the C-N bonds are polar. Nitrogen is more electronegative than carbon which is more electronegative than hydrogen. So that the hydrogen takes on a partial positive charge and the nitrogen takes on a partial negative charge. This results in an unequal sharing of the bonding electrons resulting in a net dipole for molecule since the two dipoles do not cancel out.