HOW DOES ELECTRONEGATIVITY DECIDE THE NATURE OF BOND

I hope now you have developed an understanding about atom and its behaviour. Just like we want financial stability in our life, atoms want stable electronic configuration. Every atom wants to achieve octet (8 electrons in outermost orbit). They try their best to achieve octet, either they borrow/ donate or share electrons. Do you know the best thing about atoms? They never achieve octet alone. They always achieve octet in pairs. They help each other to achieve octet by making bonds.

If one poor atom has 7 electrons and needs one more electron to achieve octet, then it will look for a partner who is richer than it, has one extra electron and also willing to donate one electron to achieve octet. In this situation they bond together by gain and loss of electron so that both of them can achieve octet. Here one atom gives its electrons to other. This type of bond is called Ionic Bond.

If one poor atom has 7 electrons and needs one more electron to achieve octet but it can't find a richer atom that has extra electron, then it will look for a companion who is similar to it and have similar needs. Both of these poor companions make a bond together by sharing their electrons and helping each other to achieve octet. This type of bond is called Covalent Bond.

We have learnt that there are two kinds of bond. One is "Ionic Bond" which we have studied in case of NaCl the table salt and other is "Covalent Bond" which we have studied in case of water molecule H2O.

Do you identify this poor atom? This poor atom is Chlorine ^{17}Cl.

^{17}Cl: $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^5$

It has 7 electrons in the outermost orbit. It needs to succeed in finding a richer atom willing to donate one electon. (guess who?) Sodium ^{11}Na.
^{11}Na: $1s^2$, $2s^2$, $2p^6$, $3s^1$

It has 8 electrons in second last (penultimate) orbit and 1 electron in last orbit. And if you recall the trend of Ionization Enthalpy you will find Na belongs to group 1 and group 1 has the least IE. That means it is easiest to remove an electron from Na.

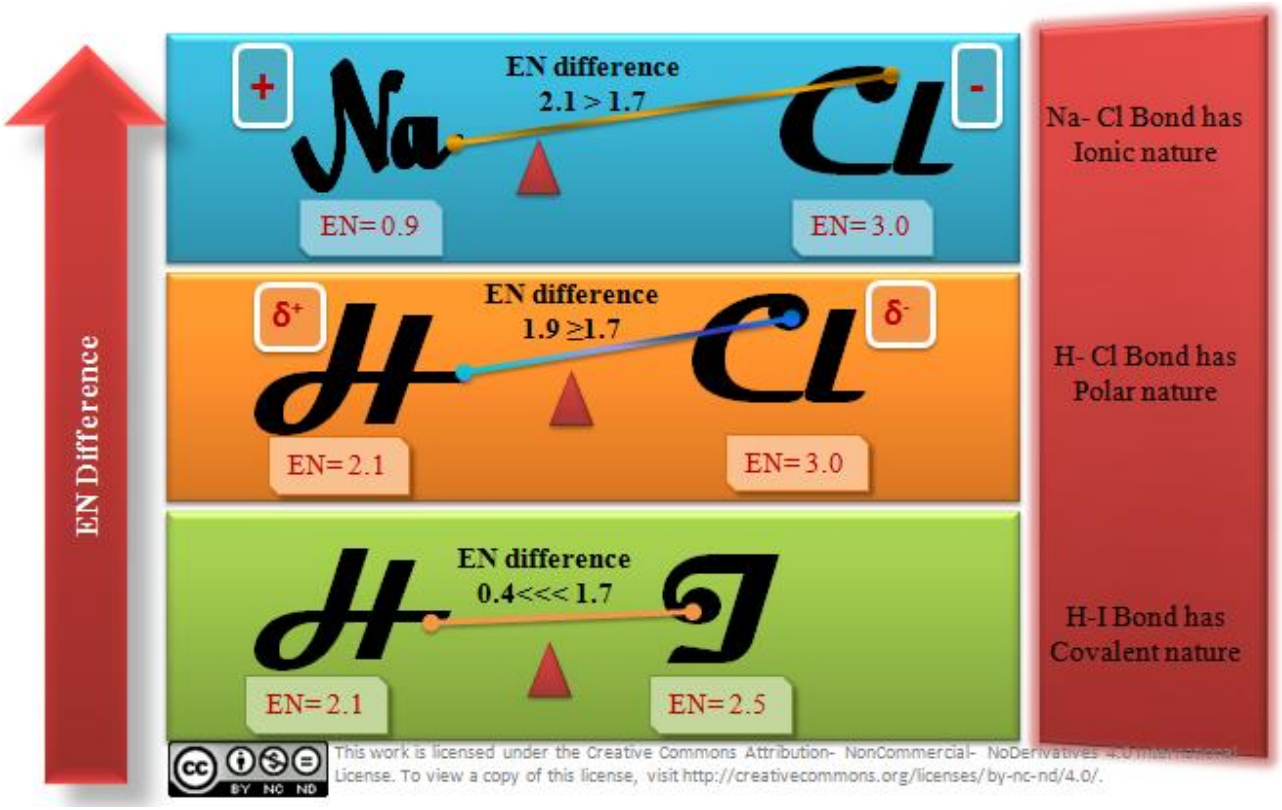
And if you recall the trend of Electron Gain Enthalpy (Electron affinity) you will find that Cl belongs to 17^{th} group which has larger negative values of EGE. That means it will accept one more electron quite happily and will release large amount of energy.

Now both Cl and Na have found themselves suitable for each other to fulfil their respective needs. The bond is formed between them by loss of 1 e^- from Na and gain of 1 e^- by Cl. When you compare Electronegativity values of them you will find Cl is more electronegative than Na. So Cl will Keep all 100% share of bonding electrons.

In other case if Cl couldn't find a richer partner who is willing to donate an electron, it finds another Cl and both share their one valence electron and make a bond. This bond is made by sharing of electrons and both Cl atoms have 50% share of bonding electron pair.

When a covalent bond is formed between two different elements, bonding electrons are shared between them but it isn't necessary that these are shared by them equally.

Bonding electrons are obliged to revolve around the orbits of the both bonded atoms. More electronegative element attracts bonding electrons and compel them to spend more time in its orbit, therefore that element develops small negative charge (delta negative δ^-) and consequently the other element will get small positive charge (delta positive δ^+). I am emphasising here on small charge because the element gets partial possession on bonding electrons; if it gets full possession, it will develop whole negative charge. By developing δ^- and δ^+charges, a covalent bond develops a polar character.



We have seen two extreme situations above, in ionic bond when one of the bonded atoms keeps all 100% share and in covalent bond when both bonded atoms have got

50% share. The percentage share of bonding electrons between bonded atoms decides the nature of bond.

If bonded elements have similar electronegativity, that is equal tendency to attract bonding electrons, the bond between them will be fairly covalent in nature, which means both elements have 50% share of bonding electron. If bonded elements have electronegativity difference more than 1.7 in Pouling scale, the more electronegative element gets the 100% share of bonding electrons and the bond will be purely ionic in nature. If bonded elements have electronegativity difference less than 1.7 in Pouling scale, the more electronegative element gets the more than 50% share of bonding electrons and the bond will be partly ionic and partly covalent in nature, which means bond has developed polar character, like in case of water molecule.

Source : http://chemistrynotmystery.blogspot.in/2014/07/how-electronegativity-decides-nature-of.html