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5 - Ions

Charged Dynamics: Exploring the World of Ions

Video 5 - Transcript

Hi everyone, welcome to video number 5. Today we're going to be exploring the electronic configuration of ions. In the last video, we learned how to write the electronic configuration of electrons in atoms. Today's concept is a bit similar, except we'll be looking at ions. Now, an atom is electrically neutral. The number of positive charges in the nucleus are equal to the number of negative charges surrounding the nucleus in the electrons. Now, some atoms have the ability to give away electrons, which leads to the formation of cations. Cations are positively charged ions. If we remember in our video about the periodic table, elements in groups 1, 2 & 3 are metals. They have 1, 2 & 3 electrons in their outermost shell, and they tend to give away electrons. Metals will tend to form positively charged ions, or cations. Now, anions are negatively charged ions. These are going to be formed by our non-metals. Those elements in groups 5, 6 & 7 that have 5, 6 & 7 electrons in the outermost shell. These atoms tend to take electrons from other atoms and become negatively charged. By giving away, in the case of metals - by giving away electrons. Or in the case of non metals, by accepting electrons, we obtain a full outermost shell. If we remember, atoms want to obtain a full outermost shell so that they are stable, We can demonstrate this. Let's look at sodium. Sodium symbol Na has an electronic configuration like this. 1s2, 2s2, 2p6 and 3s1. Sodium has an atomic number of 11. We get 2 +2 + 6 + 1 = 11 protons in the nucleus of this atom. Also, because we know atoms are electrically neutral, then this also represents the arrangement of the electrons around the nucleus of my sodium atom. Sodium is in group 1. Sodium has one electron in its outermost shell. I can draw sodium like this. The first two, First two is this. Then I have eight in my second shell and then I have my 3s1 This is my valence electron. Okay? What sodium will do is sodium will give away this electron to, for example, a non metal that will accept it. Sodium will become positively charged. Okay? So that the electronic configuration of sodium - Na+ ion becomes 1s2, 2s2, and 2p6. Na+ is now stable - we have a full outermost shell, 2 and 8. Now we can show another example. And we can demonstrate the same concept using an aluminum ion. We can show this formation of positively charged ions, or cations, using another example. Let's try aluminium this time. Al has an atomic number of 13. We can write the electronic configuration of aluminum. 1s2, 2s2, 2p6, 3s2 and 3p1. This is the electronic configuration of my electrically neutral aluminium atom. Aluminium is in group three. Therefore, aluminium is a metal. Aluminium will give away the three electrons in its outermost shell. I can draw like this, like we've just done for sodium. I'm going to fill in my electrons - here we have the three valence electrons in the outermost shell. What aluminium will do when it gives away these three is it becomes Al3+ The electronic configuration of Al3+ cation, is 1s2, 2s2, 2p6. Now let's look at something very interesting, the electronic configuration of Al3+ is exactly the same as the electronic configuration of Na+ Now, that does not mean that Al3+ and Na+ are the same species. They have completely different mass numbers and they are completely different ions. The human body needs sodium, for example, to conduct nerve impulses, contract and relax muscles, and to maintain the proper balance of water and minerals. And there is no known physiological use for aluminum. Now let's look at groups 5, 6 & 7. Now let's turn to our non metals, and let's take a look at elements in groups 5, 6 & 7. Let's take chlorine, for example. Chlorine is a non metal. Basically, chlorine will accept electrons in order to become negatively charged ions. The electronic configuration of chlorine is 1s2, 2s2, 2p6, 3s2, 3p5 We can draw chlorine like this. We have two in the first shell, eight in the second shell, and seven in the third shell. Two here, eight in the second shell, and then seven in the third shell. Chlorine, as you can see, just needs one electron to complete its outermost shell. Therefore, chlorine will accept an electron from some other element, most likely a metal - and in that case. Chlorine will then have an electronic configuration like this 1s2, 2s2, 2p6, 3s2, 3p6 This is the electronic configuration of our Cl- ion. All that's left now is our group 4 elements. Remember we have looked at groups 1, 2 & 3 These are my metals. And these will give away electrons to become positively charged ions. Groups 5, 6 & 7 - these are my non metals that will accept electrons to become negatively charged ions. Group four - Remember the group number tells us the number of electrons in the outermost shell. Let's take for example, carbon. Carbon has four electrons in its outermost shell. Therefore, carbon and other group four elements, they neither give away nor do they accept. What elements in group 4 tend to do is they tend to share electrons through covalent bonding. Basically, we have our metals forming cations, and our non metals forming anions. Group eight, as we mentioned before, are the noble gases, and these already have their outermost shells filled, so they do not participate in bonding. I hope that you can now write the electronic configuration of all of your atoms, 1-20 in the periodic table, as well as the electronic configuration of the ions that are formed by our metals, as well as our non metals. That's all for today. I'll see you in the next video.