Guiding Question revisited

What determines the ionic nature and properties of a compound?

In this chapter we have developed an ionic model to explain the structure and properties of many compounds formed between metals and non-metals. This model is particularly effective in describing the properties of compounds formed between elements at different sides of the periodic table: the group 1 halides. The model does however have some limitations and other compounds show ionic properties to varying degrees as the bonding shows covalent character.

- [ ] An ion is a charged particle formed when atoms lose or gain electrons.
- [ ] Metals lose electrons to form positive ions (cations); non-metals gain electrons to form negative ions (anions).
- [ ] The number of charges on an ion is equal to the number of electrons lost (positive ion) or gained (negative ion) by an atom.
- [ ] The charge on an ion can usually be predicted from the group of the element in the periodic table; transition metal elements can form ions with different charges.
- [ ] The formula of common molecular ions can be related to the molecular formula of common acids.
- [ ] Ionic lattices consist of ions held together by ionic bonds which are electrostatic forces of attraction.
- [ ] Ionic compounds are electrically neutral as the total number of positive charges is balanced by the total number of negative charges.
- [ ] The formula of the compound is expressed as its simplest ratio, e.g. the ions X^{m+} and Y^{n-} will form the compound X_nY_m. The unit formula of an ionic compound is also the empirical formula.
- [ ] Ionic compounds usually have high melting and boiling points, and are more soluble in **polar** solvents such as water than in **non-polar** solvents.
- [ ] Positive ions are attracted to the O atom in a water molecule, which has a partial negative charge. Negative ions are attracted to the H atoms, which have a partial positive charge.
- [ ] Ions are not free to move in the solid state, so ionic compounds do not conduct electricity in the solid state. They can, however, conduct electricity when molten or in aqueous solution as the ions are free to move.
- [ ] The difference in electronegativities of two atoms gives an indication of the ionic character of the compound.
- [ ] Most ionic compounds are formed between metals on the bottom left of the periodic table and non-metals on the top right, excluding the noble gases.
- [ ] Ionic and covalent bonding are two extremes as many substances show intermediate character. The nature of the bonding can be related to bond polarity and the difference in electronegativity values ($\Delta\chi_p$) of the bonded atoms.