Problem solving and Calculations

SET 9: Ionisation Energy-Answers

1. Ionisation energy is the energy required to remove an electron from the outer most energy level of an atom to form a positive ion. For example a sodium atom has 11 protons and 11 electrons. The first time it is ionised it loses one electron leaving a +1 charge as the Na+ ion is formed. It now has 11 protons and 10 electrons. This can be summarised as:

$$Na + energy \longrightarrow Na^{+} + e^{-}$$

2. In order to remove an electron from an atom, energy is supplied and these atoms are most often in the gaseous state as a result.

3. There is a pattern in the amount of energy required to remove an electron from atoms as you move across a period, hence periodicity. The pattern is that the amount of energy increases moving from left to right across a period.

4. There is no set relationship between ionization energy and reactivity of atoms, however there are some patterns. The highest ionization energies are for the inert gases which are the most stable group in the periodic table. The next highest ionization energy is for the halogens yet these are very reactive non-metals. The lowest ionization energies are for the group 1 metals which are very reactive.

5. Magnesium has 2 electrons in its outer shell and tends to lose these electrons relatively easily and forms a 2^{+} ion. If it were to lose a third electron, it would be coming from an energy level closer to the nucleus and this would require a very large increase in energy to remove it. As a result magnesium will not easily from the 3^{+} ion.

6. a) 3
   b) The energy required to take away the 4th electron jumps by a large amount suggesting that the 4th electron has come from an energy level closer to the nucleus than the other 3 electrons.
   c) Yes they will be similar in shape, but as you go down the group the jump for the 4th electron would be much less.

7. F has 2 valence electrons as there is a large jump after 2 suggesting that the 3rd electron has come from an energy level closer to the nucleus than the other 2 electrons.

8. A, as it has 1 valence electron.

9. E, as it has 3 valence electrons.

10. If there is a low number of valence electrons ie. 1, 2 or 3; to achieve a stable octet the electrons could be lost forming ions hence there would be ionic bonding. If there is a high number of valence electrons ie. 5, 6 or 7; then electrons could be gained forming ions hence there would be ionic bonding. Alternatively for elements with 5, 6, or 7 valence electrons to achieve a stable octet electrons could be shared creating covalent bonding.