GROUP 7: OXIDISING ABILITY

1. a) A very pale green gas passed through a colourless solution gives an orange solution.

   b) $Cl_2 + 2Br^- \longrightarrow 2Cl^- + Br_2$

   c) Electrons are being lost and gained. The chlorine is gaining electrons and so is being reduced. The bromide ions are losing electrons and so are being oxidised.

   d) The fluorine will also oxidise the water present to give HF and oxygen.

   e) Oxidising ability falls as you go down the group.

2. a) (i) The energy needed to produce 1 mole of isolated gaseous atoms starting from an element in its standard state.

   (ii) The electron affinity is the energy released when 1 mole of gaseous atoms each acquire an electron to form 1 mole of gaseous 1- ions. (If you are just asked to define electron affinity, you can assume that you are being asked for first electron affinity.)

   (iii) This is the energy released when 1 mole of gaseous ions dissolves in water to produce hydrated ions.

   b) Electron affinity is a measure of the attraction between the incoming electron and the nucleus. The higher the attraction, the larger the electron affinity. As you go down the group, the incoming electron is farther from the nucleus, and the increase in number of protons is balanced by the increase in the number of screening electrons. The greater distance means a weaker attraction.

   c) Fluorine is a very small atom. The incoming electron is therefore going into a very electron-dense region which causes repulsions which more than offset the closeness of the new electron to the nucleus.

   d) Halogen-halogen bonds have to be broken when all the halogens are atomised, and the strength of the bond will generally fall as the atoms get bigger.. Although the F-F bond is short, it is much weaker than you might expect. This is due to repulsions between the lone pairs on the two fluorine atoms which are very close together in the F-F bond.

   e) Hydration enthalpies are a measure of the attractions between water molecules and the ion they are surrounding. For ions with the same charge, the smaller the ion, the greater the attraction. As the ions get bigger as you go down the group, the attractions get weaker, and hydration enthalpy falls.

   f) The final column shows the enthalpy change for the half-reaction

   $$\tfrac{1}{2}X_{2(s,\ l\ or\ g))} + e^- \longrightarrow X^-_{(aq)}$$

   It shows that the heat evolved for this reaction decreases as you go down the group. The reaction is

what happens when the halogens act as oxidising agents, removing electrons from other things. In energetic terms, the figures show that the reaction is most successful for fluorine and least successful for iodine.

g) The changes in hydration enthalpy and in electron affinity.