PERIOD 3: PROPERTIES OF THE "HYDROXIDES"

1. a) They both contain hydroxide ions which are a strong base, reacting with hydrogen ions to make water.

   b) $NaOH + HCl \longrightarrow NaCl + H_2O$

   $Mg(OH)_2 + 2HCl \longrightarrow MgCl_2 + 2H_2O$

   You could equally well write equations with HNO_3 or H_2SO_4, which is fine. Check that your equations balance and that the formulae of the products is right - $NaNO_3$, $Mg(NO_3)_2$, Na_2SO_4, $MgSO_4$. But given a choice, always go for the simplest option!

2. a) It reacts as both an acid and a base. In other words, it will react *with* a base or *with* an acid.

   b) Acting as a base (i.e. *with* an acid)

   $Al(OH)_3 + 3HCl \longrightarrow AlCl_3 + 3H_2O$

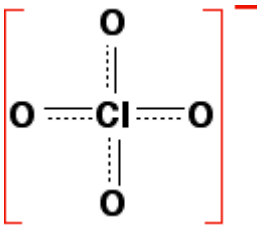
   Acting as an acid (i.e. *with* a base)

   $Al(OH)_3 + NaOH \longrightarrow NaAl(OH)_4$

3. a) Orthosilicic acid is very weak, phosphoric(V) acid is weak, sulphuric acid and chloric(VII) acid are both strong.

   b) If a hydrogen ion is lost from one of the OH groups, the remaining oxygen has a negative charge. Unless this can be delocalised (spread around), it will be very attractive to hydrogen ions and the original acid will reform - the acid will be weak. On the other hand, if the charge can be delocalised, the ion will be much less likely to attract a hydrogen ion, and so the acid will stay ionised - it will be strong.

   The charge can be delocalised by interaction with the electrons in the element-oxygen double bonds. With the chlorate(VII) ion, the charge is delocalised over all four oxygen atoms.

   If you draw a similar structure for the HSO_4^- ion, it is delocalised over three oxygen atoms (the one that originally carried the charge, and the two S=O oxygens), which is almost as effective.

   With the $H_2PO_4^-$ ion, it is delocalised over only two oxygen atoms, and in the $H_3SiO_4^-$ ion it is entirely localised on the original oxygen, which still carries the entire charge. So phosphoric acid is weaker than sulphuric acid or chloric(VII) acid, and orthosilicic acid is very weak indeed.

   Therefore, the strength of the acid depends on the number of element-oxygen double bonds which can help to delocalise the negative charge.