GROUP 4: OXIDES

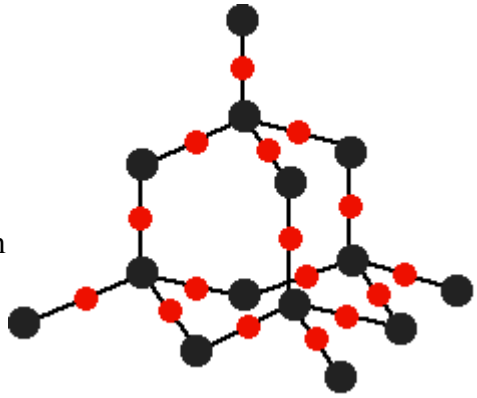
1. a) Carbon dioxide is a gas, and the other dioxides are high melting point solids.

b) (i) There are C=O double bonds consisting of a sigma bond and a pi bond.

(ii) The silicon (etc) atoms are too big for there to be successful sideways overlap between their p orbitals and the p orbitals on the carbon to form pi bonds. That means that silicon and oxygen are restricted to single bonds between them.

c) Giant covalent structure.

(If you have used some alternative structure that you have already learnt and which is acceptable to your examiners, check your diagram carefully against that.)



2. a) It reacts with hot concentrated sodium hydroxide solution.

$$NaOH + CO \longrightarrow HCOONa$$

b) (i) $H_2O_{(l)} + CO_{2(aq)} \rightleftharpoons H^+_{(aq)} + HCO^-_{3\,(aq)}$

(ii) Where the sodium hydroxide is in excess:

$$2NaOH + CO_2 \longrightarrow Na_2CO_3 + H_2O$$

Where the carbon dioxide is in excess:

$$NaOH + CO_2 \longrightarrow NaHCO_3$$

(You obviously need more carbon dioxide in relation to the amount of sodium hydroxide in the second case than the first.)

c) (i) $2NaOH + SiO_2 \longrightarrow Na_2SiO_3 + H_2O$

The product is sodium silicate.

(ii) $CaO + SiO_2 \longrightarrow CaSiO_3$

d) Amphoteric means that they can react with both acids and bases. Or the equivalent: They have both basic and acidic properties.

e) (i) $SnO + 2HCl \longrightarrow SnCl_2 + H_2O$

(ii) $SnO + 2NaOH \longrightarrow Na_2SnO_2 + H_2O$

or, if you have written the ionic version from the Chemguide page:

$$SnO + 2OH^- \longrightarrow SnO_2^{2-} + H_2O$$

If you have written versions involving complex ions such as $[Sn(OH)_4]^{2-}$, then check those against whatever source you are using.

f) (i) The complication here is that the tin(IV) chloride that is originally produced will react with the chloride ions in an excess of concentrated hydrochloric acid to give the complex Na_2SnCl_6 containing the $SnCl_6^{2-}$ ion.

This is most easily done as two separate equations:

$$SnO_2 + 4HCl \longrightarrow SnCl_4 + 2H_2O$$

$$SnCl_4 + 2Cl^- \longrightarrow SnCl_6^{2-}$$

(ii) $SnO_2 + 2OH^- + 2H_2O \longrightarrow [Sn(OH)_6]^{2-}$

This is the version given on the Chemguide page. If you have used another version which is in agreement with whatever your examiners are asking, check your answer against that.

g) The product of the reaction would be lead(II) chloride, which is only very sparingly soluble in water. A solid layer of this quickly forms on the lead(II) oxide, and prevents it from reacting with any further hydrochloric acid.

Before you get too worried about this tedious chemistry in Question 2, make sure you need to know it! Don't rely on what your syllabus says, but check past exam papers and their mark schemes, and Examiner's Reports if they are available. It is really important that you know exactly what your examiners expect, and how often it comes up. If something comes up just once in 10 years, worth 1 mark, frankly there are probably better uses of your time.