PERIOD 3: ACID-BASE REACTIONS OF THE OXIDES

1. a) (i) Na_2O

(ii) The presence of the very basic oxide ions, O^{2-}.

(iii) $Na_2O + 2HCl \longrightarrow 2NaCl + H_2O$

(iv) $Na_2O + H_2O \longrightarrow 2NaOH$

b) (i) MgO

(ii) There are much stronger attractions between 2+ and 2- ions than between 1+ and 2- ions. The oxide ions aren't so free to react with acids as they are in sodium oxide.

c) (i) Aluminium oxide (Note that you are asked for a name, not a formula. It won't necessarily matter if you give the formula, but it might. Don't take chances.)

(ii) Amphoteric means that it reacts as both a base and an acid. That means that it will react with an acid or with a base.

Reacting as a base (reacting *with* an acid):

$$Al_2O_3 + 6HCl \longrightarrow 2AlCl_3 + 3H_2O$$

Reacting as an acid (reacting *with* a base):

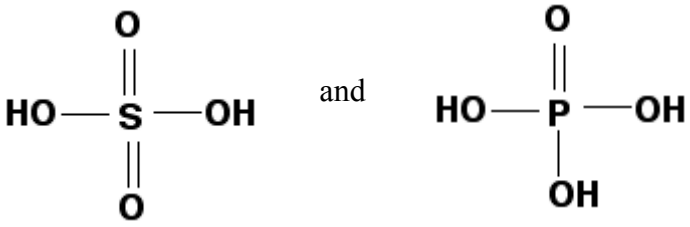
$$Al_2O_3 + 2NaOH + 3H_2O \longrightarrow 2NaAl(OH)_4$$

(If you have been taught a different version of this equation producing either $NaAlO_2$ or $Na_3Al(OH)_6$, then use that one instead, but make sure that it balances properly.)

d) (i) $SO_3 + H_2O \longrightarrow H_2SO_4$

$P_4O_{10} + 6H_2O \longrightarrow 4H_3PO_4$

(ii) Sulphuric acid. The structures are:

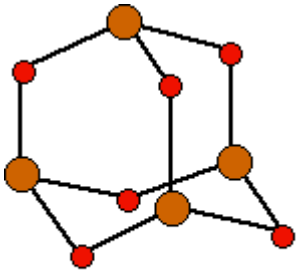


When either acid loses a hydrogen ion from one of the OH groups, it leaves a negative charge on the oxygen. This can be delocalised over the rest of the structure by interaction with the electrons in the C=O double bond(s). There are two such bonds in the ion from the sulphuric acid, but only one with the phosphoric(V) acid. The more the delocalisation, the more stable the ion, and the more likely it is to form, and remain as an ion rather than reacting with a hydrogen ion again.

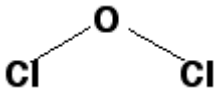
(iii) The easiest would be to use the one on the Chemguide page:

. . . but you could equally well give an equation with MgO (just like the one above) or with Na_2O to produce Na_2SO_4 - or something similar.

2. a) One of the following:

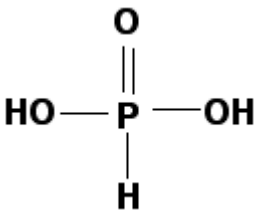


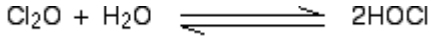
a P_4O_6 molecule



I have taken all of these from Chemguide pages to save the bother of redrawing them. If you have used the phosphorus one, you should, of course, label the atoms properly. The small red ones are oxygen and the larger orange-brown ones are phosphorus.

b) One of the following:





H-O-Cl

(In the last case, you could equally well write the product in the equation as HClO, but that doesn't show the structure of course.)

c) Which ever you chose, they are all weak acids. The HOCl is very weak, but the question doesn't ask you that.