GROUP 2: REACTIONS WITH AIR AND OXYGEN

1. a) beryllium, magnesium and calcium

   b) strontium

   c) barium

   d) $2Mg + O_2 \longrightarrow 2MgO$

   (or the equivalent with either Be or Ca)

   e) $Ba + O_2 \longrightarrow BaO_2$

   (or the equivalent with Sr)

   d) The more complicated peroxide ion has two oxygen atoms, each with a negative charge and joined by a single bond. (Easier to draw a quick diagram.) In the presence of a positive ion with a high charge density, this is polarised so much that it can turn into a simple oxide ion and shed an oxygen atom (which ends up in an O_2 molecule). This happens with the smaller positive ions at the top of the group.

   As the positive ions get bigger towards the bottom of the group, their charge densities aren't high enough for this to happen, and so the peroxide ion remains intact.

2. a) $3Mg + N_2 \longrightarrow Mg_3N_2$

   b) Nitrogen is fairly unreactive because of the very high bond strength of the nitrogen-nitrogen triple bond. A lot of energy has to be put in to break it. In this case, you also have to put in energy to ionise the magnesium and to form the N^{3-} ions. The only way you can get this large amount of energy back is if the lattice energy released when the ions form a crystal is high enough.

   When 2+ ions form a lattice with 3- ions, the amount of lattice energy released is huge (because of the very strong attractive forces), and more than compensates for the energy input terms.

   With 1+ ions, the lattice energy isn't big enough, and so the nitride doesn't form. Lithium is an exception because the ion is very small – the smaller the ion, the larger the lattice energy. So in lithium's case, enough energy is released to compensate for the energy input terms.