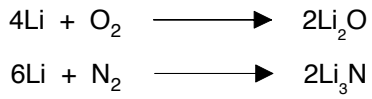
GROUP 1: REACTIONS WITH OXYGEN AND CHLORINE

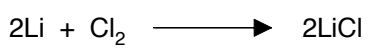
1. a) Lithium oxide and lithium nitride.



$$4Li + O_2 \longrightarrow 2Li_2O$$

$$6Li + N_2 \longrightarrow 2Li_3N$$

b) Lithium would burn with a red flame to produce a white solid product – lithium chloride.



$$2Li + Cl_2 \longrightarrow 2LiCl$$

2. a) Na_2O, K_2O_2 and CsO_2

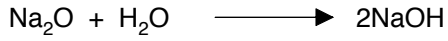
b) Any diagram showing two oxygen atoms joined by a single bond, and with a negative charge on each oxygen. You don't need to draw a dots-and-crosses diagram, but it would be OK (provided it is right!) showing a single pair of shared electrons, and the negative charge on each atom.

c) The O-O single bond in the peroxide ion is quite weak, and a nearby positive charge will polarise it strongly, possibly to the point that both negative charges will end up on the oxygen nearest the positive charge to form a simple oxide ion. The remaining oxygen atom breaks away and will end up in an oxygen molecule as oxygen gas.

This is most effective if the positive ion has a high charge density – in other words, a lot of charge packed into a small volume. In the lithium case, the charge density is high because of the small size of the atom. Any peroxide ion nearby would be instantly converted into an oxide ion and oxygen. Sodium is bigger, and so the charge density is lower, and the peroxide ion remains intact.

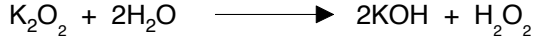
d) Where there is a choice of compounds to be formed, you will get the one which is the most energetically stable. (Use the term *energetically stable*, not just *stable*.) That is the one in which the most energy is released in its formation – in this case, the superoxide.

3. a)



$$Na_2O + H_2O \longrightarrow 2NaOH$$

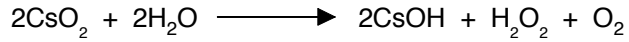
b)



$$K_2O_2 + 2H_2O \longrightarrow 2KOH + H_2O_2$$

The reaction is very exothermic, and the heat evolved decomposes the hydrogen peroxide to give water and oxygen.

c)



$$2CsO_2 + 2H_2O \longrightarrow 2CsOH + H_2O_2 + O_2$$

4. a) lithium chloride and water

b) sodium chloride and hydrogen peroxide. But the reaction is very exothermic, and the hydrogen peroxide would decompose on warming to give oxygen and more water.

c) caesium chloride, hydrogen peroxide and oxygen. Again the reaction is very exothermic, and the hydrogen peroxide would decompose to form oxygen and more water.