GROUP 1: REACTIONS WITH WATER

1. a) $2K_{(s)} + 2H_2O_{(l)} \longrightarrow 2KOH_{(aq)} + H_{2(g)}$

   b) (i) The heat given out by the reaction melts the low-melting point sodium.

   (ii) Hydrogen gas is evolved and the sodium is pushed around the surface by that.

   (iii) sodium hydroxide

   (iv) The heat released by the reaction (and no longer being spread around the water by the movement of the sodium) is enough to ignite the hydrogen. It burns with an orange flame rather than a blue one because it is contaminated by sodium compounds.

   (v) The hydrogen is ignited right from the start, and burns with a lilac flame. The reaction is over much more quickly.

2. a) Reactivity increases down the group

   b) $Na_{(s)} \longrightarrow Na_{(g)}$

   c) Atomisation energy falls as you go down the group. It is a measure of the forces of attraction holding the metal atoms together in the solid. All of the Group 1 elements have metallic bonding. As you go down the group, the atoms get bigger, and the delocalised electrons are further away from the attraction of the nuclei. That weakens the bond.

   d) $Na_{(g)} \longrightarrow Na^+_{(g)} + e^-$

   e) First ionisation energy falls. The increase in nuclear charge is exactly offset by the increase in the amount of screening the outer electron experiences, but the outer electron is getting further away from the nucleus, and so is easier to remove.

   f) What matters in how fast these reactions work isn't so much the overall enthalpy change, but the activation energy for the reactions. Reactions will happen faster if the activation energy is smaller.

   During these reactions, the major terms affecting the amount of energy which has to be put in to get the reactions started are ionisation energy and, to a lesser extent, atomisation energy. Both of these fall as you go down the group, and so the activation energy for the reactions is likely to fall as well.