1.Title

Investigation of s-block elements

2.Aim

The purpose of this experiment is to examine the flame colour of selected s-block metal chlorides and the solubility of selected Group II metal sulphates and hydroxides.

3.Results & Calculations

Table 1

Group I		Group II	
compound	flame color	compound	flame color
LiCl	Deep red	$CaCl_2$	Brick - red
NaCl	Golden yellow	$SrCl_2$	Blood – red
KCl	Lilac	$BaCl_2$	Green

Table 2

Cationic solution				
Anionic solution	$Mg(NO_3)_2(aq)$	$Ca(NO_3)_2(aq)$	$Sr(NO_3)_2(aq)$	$Ba(NO_3)_2(aq)$
NaOH(aq) Trend	Least soluble	more soluble when compared with $Mg(NO_3)_2$	more soluble when compared with $Ca(NO_3)_2$	Most soluble
Na_2SO_4 (aq) Trend	Most soluble	Less soluble when compared with $Mg(NO_3)_2$	Less soluble when compared with $Ca(NO_3)_2$	Least soluble

4.Discussion

Flame colour: Most s – block elements give a characteristic flame colour in the flame test. The test is done by putting a sample of the elements or their compounds into a non – luminous Bunsen flame. Since the outermost shell electrons of atoms of both Groups I and II elements are weakly held by the nucleus, the electrons are easily excited to higher energy levels upon heating.

When these electrons return to their ground states, radiation is emitted. For many Groups I and II elements, the emitted radiation falls into the visible light region of the electromagnetic spectrum. Since the amount of energy of the emitted radiation is quantized, the flame colour is a characteristic property of the element.

Solubility: When an ionic solid dissolves in water, two processes are taking place. They are the breakdown of the ionic lattice, and the subsequent stabilization of the ions by water molecules (this process is called hydration).

When an ionic solid dissolves in water, there must be energetically favourable interactions between the water molecules and the dissolved ions. These interactions compensate for the breaking of ionic bonds present in the ionic lattice. This can be considered from the point of view of energetics. The first process involves a release of energy when the ions are hydrated, that is , when new bonds are formed between the ions and water molecules.

5. Answers to Question

5.1 Account for the underlying principle of flame test.

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5.2 Based on the observed trend, explain the solubility of selected Group II metal sulphates and hydroxides in terms of

lattice enthalpy and hydration enthalpy.

For the sulphates(VI) of Group II metals, the cations are much smaller than the anions. The $\triangle H_{lattice}$ is mainly determined by the reciprocal of the sum of cationic and anionic radii (i.e. $1/(r^+ + r^-)$). The large ionic radius of the anionic makes the sizes of the much smaller cations relatively insignificant in contributing to the sum of r^+ and r^-. Therefore, going down the group, the increase in size of the cations does not cause a significant change in the $\triangle H_{lattice}$. However, the increase in size of the cations does cause the $\triangle H_{hyd}$ to become less negative down the group. That is to say, the decrease in $\triangle H_{hyd}$ is more significant than the decrease in H lattice. As a result, the $\triangle H_{soln}$ becomes less negative, and hence the solubility of the sulphates(VI) of Group II metals decreases down the group.

For the hydroxides of Group II metals, the sizes of anions and cations are of the same order of magnitude. Again, the $\triangle H_{lattice}$ is proportional to $1/(r^+ + r^-)$. Going down the group, less energy is required to break down the ionic lattice (i.e. the $\triangle H_{lattice}$ becomes less negative) as the cationic size increases, and the change in $\triangle H_{hyd}$ is comparatively small. That is to say, the decrease in $\triangle H_{soln}$ becomes more negative, and hence the solubility of the hydroxides of Group II metals increases down the group.

6. Conclusion

The flame colour of selected s – block metal chlorides are different since the amount of energy of emitted radiation is quantized. At the same time, the solubility of selected Group II metal sulphates decreases down the group. However, the solubility of selected Group II metal hydroxides increases down the group.