# 1.7 ACTIVITY: FLAME TESTS

**(Pages 23–24)**

## Analysis

(a)

**Table 1** Flame Test Key for Some Metallic Compounds

| Metallic compound | Flame test colour |
|---|---|
| sodium nitrate, $NaNO_{3(s)}$ | yellow |
| sodium chloride, $NaCl_{(s)}$ | yellow |
| aqueous sodium chloride, $NaCl_{(aq)}$ | yellow |
| calcium chloride, $CaCl_{2(s)}$ | yellow-red |
| strontium chloride, $SrCl_{2(s)}$ | red |
| lithium chloride, $LiCl_{(s)}$ | red |
| potassium chloride, $KCl_{(s)}$ | violet |
| copper(II) chloride, $CuCl_{2(s)}$ | blue |

(b) The colour of the flame of the unidentified metal will vary depending on which metallic compound students are provided with.

## Evaluation

(c) One possible source of error in this activity would occur if the unidentified metallic compound consisted of strontium or lithium. Since strontium and lithium compounds both produce a red colour during a flame test, it is difficult to tell them apart using this method alone. To eliminate this source of error, you could perform other qualitative analysis tests, such as examining the compounds before they are placed into the flame to note any physical differences, such as colour in solution, or examining the line spectra of their elements. Another possible source of error is failure to properly clean the nichrome wire after each flame test. If a metallic compound is not thoroughly removed after each test, it may produce a colour that will mask or alter the colour of the next compound being tested. The flame test key will then be inaccurate, which will make it more difficult to correctly identify the unidentified compound. Making sure that the nichrome wire is cleaned thoroughly between flame tests will help avoid this error.

(d) The flame colour produced for solid sodium nitrate, solid sodium chloride, and sodium chloride solution is yellow. This result indicates that (1) sodium is responsible for the yellow colour since it is the common element in all three samples, and that (2) the state of the sample (solid or aqueous) has no effect on the colour of the flame.

(e) Without cobalt glass, the flame of a sodium compound appears yellow. When cobalt glass is placed in front of the sodium flame, the yellow colour of sodium is filtered out and we do not see the flame. When cobalt glass is placed in front of the flame produced by potassium chloride, the original violet flame now appears red. Cobalt glass filters out yellow light. Cobalt glass is an additional qualitative analysis tool that can be used to further validate the identity of metals.

## Synthesis

(f) The metal in the first photo is calcium, the metal in the second photo is copper, the metal in the third photo is sodium, and the metal in the fourth photo is either strontium or lithium.

(g) Qualitative analysis allows you to identify a substance by comparing its physical and/or chemical properties to the physical and/or chemical properties of identified substances. Since each metallic compound burns with a flame of a characteristic colour when subjected to a flame test, this property can be used to identify metallic compounds. In this activity, we created a key for the flame colours of identified solids and solutions of metallic compounds. We then used this information to identify a metallic compound by subjecting it to a flame test, observing the colour of the flame, then comparing this colour to the colours of the metallic compounds in the flame test key.

(h) Flame emission spectroscopy is used to detect the presence of trace alkali metals in concrete. Flame emission spectroscopy is also used to detect trace metals in crops, soil (lead), shellfish (mercury), mineral water, and physiological fluids.