### Flame Test Chart

<table>
<thead>
<tr>
<th>substance</th>
<th>lithium compound</th>
<th>sodium compound</th>
<th>potassium compound</th>
<th>rubidium compound</th>
<th>caesium compound</th>
</tr>
</thead>
<tbody>
<tr>
<td>colour of flame</td>
<td>bright red</td>
<td>bright orange</td>
<td>pale lilac</td>
<td>dark red</td>
<td>blue</td>
</tr>
<tr>
<td>liquid fertilizer colour of flame</td>
<td></td>
<td></td>
<td>pale lilac</td>
<td></td>
<td></td>
</tr>
<tr>
<td>baking soda colour of flame</td>
<td></td>
<td></td>
<td>bright orange</td>
<td></td>
<td></td>
</tr>
<tr>
<td>kitchen salt colour of flame</td>
<td></td>
<td></td>
<td>bright orange</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Fertilizer contains:** potassium

**Baking soda contains:** sodium

**Kitchen salt contains:** sodium

Where alkali metals are found, too:

<table>
<thead>
<tr>
<th>lithium</th>
<th>sodium</th>
<th>potassium</th>
<th>rubidium</th>
<th>caesium</th>
</tr>
</thead>
<tbody>
<tr>
<td>fireworks, batteries, alloy for space travel, laboratory glass, medicine</td>
<td>fireworks, street lamps, batteries, pretzels, glass, cooling agent for nuclear reactors</td>
<td>matches, gunpowder, optical glass</td>
<td>photocells, medical research about the heart muscle</td>
<td>photocells, S-ray source, atomic clock, infrared lamp</td>
</tr>
</tbody>
</table>

### Chemical background

Every atom has a nucleus and small electrons moving around it. The further the electrons are away from the nucleus, the more energy the electrons have. If a metal atom is heated, the electrons get enough energy to jump further away from the nucleus. When they fall back closer to the nucleus, they give off their extra energy as light. Different metals and their compounds produce their specific coloured light. We can detect the different metals and their compounds by the colour of the light they emit.

verändert nach [4]
The Name “Potassium”

▼ CHEMICALS
Wood ash as found in a barbecue or fire place, distilled water, hydrochloric acid

▼ APPARATUS
Beaker, funnel, filter paper, evaporating dish, Bunsen burner, tripod, wire mesh, magnesia stick

▼ SETUP

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Step 2</th>
<th>Step 3</th>
<th>Step 4</th>
</tr>
</thead>
</table>

▼ PROCEDURE
1. Put the wood ash into a beaker and add distilled water until well covered. Set aside until the next Chemistry lesson.
2. Filter the wood ash-water-mixture.
3. Heat the filtrate (the liquid obtained by filtering) in an evaporating dish until all water has evaporated.
4. Use the remaining solid substance for a flame test.

▼ OBSERVATION
The wood ash doesn’t dissolve well. The filtrate is a clear yellow solution. After the evaporation of the solvent (water) a yellow-brown solid remains. The flame test with this substance shows a pale lilac flame.

▼ CONCLUSION
Potassium and its compounds can be detected by their typical pale lilac flame colour. This proofs that there are potassium compounds in the wood ash. Wood ash was an important substance in earlier times. It was used to make glass and soap. Since it was produced in iron pots, wood ash was also called “potash”. Humphrey Davy, a Chemist of the 19th century, discovered a chemical element in potash which then was called “Potassium”. Note the similarity: potash – potassium! By the way: the Arabic name for potash is al-kali!

Synthesis of Sodium Chloride

Assignment
1) Open the link http://jchemed.chem.wisc.edu/jcesoft/cca/cca0/Movies/NACL1.html and watch the video about the synthesis of sodium chloride.
2) Write a protocol about this experiment. This should contain the usual parts: headline, set up (labelled), procedure, observation and conclusion. You may use the copy and paste function where possible. Use your own words in cases where this is not possible.
3) Answer the in your conclusion:
   a) Is the reaction between sodium and chlorine endo- or exothermic? Give evidence from the video to support your answer.
   b) Why was a drop of water necessary to start the reaction?
4) Give the chemical equation of the synthesis of sodium chloride in words and symbols.
Multi-word fill quiz on ALKALI METALS

Fill in all the gaps with ONE word or number using lower case characters unless a capital letter is needed e.g. for a chemical symbol.

The elements in Group _____ of the periodic table are known as the ___________ metals because they form ________ which dissolve in water and give alkaline solutions. They are metals with __________ density and the first three in the Group are less dense than water, and so they ___________ .

They have unusually low ___________ points and the solids are quite _________ .

They react with non-metals such as oxygen and __________ to form salt compounds in which the metal carries a valence of ________ . These salt-like chloride compounds are __________ solids which dissolve in water to form ___________ neutral solutions of pH ________ .

The formula for sodium chloride is ___________ and sodium hydroxide is ___________ .

The alkali metals react exothermically with water releasing ___________ and forming soluble alkaline hydroxides.

When a piece of ___________ , sodium or potassium is placed in __________ water the metal _________ because of its low ___________ .

It may melt and move around the surface with lots of ___________ .

The more reactive the metal, the ___________ the reaction with water. A simple laboratory test for the _________ ___________ gas is that when a test tube of the gas is held to a ___________ the gas burns in the air with a squeaky ___________ . During the reaction ___________ indicator will turn from ___________ to ___________ .

In Group 1, the further ___________ the group the ___________ reactive the alkali metal and the ___________ its melting point and boiling point.
Test your knowledge about alkalimetals

1. Explain, how we found out that sodium is a metal. Draw a sketch to support your explanation.

2. Note at least six properties of sodium.

3. Sodium is put into water that contains phenolphthalein as an indicator. What can be observed? Also write down the chemical equation in words (Wortgleichung) and with symbols (Symbolgleichung).

4. How do the properties of the alkali metals change as you go down that group in the periodic system?

5. Fertilizer (Pflanzendünger) contains one of the alkali metals. Name a test to find out which one it is. What will be observed in this test in case fertilizer contains potassium?

6. What did we do to find out which gas is produced, when sodium reacts with water? Add a sketch to your text!

7. Pretzels (Laugenbrezeln) are dipped into „Brezel-Lauge“ before they are baked. „Brezel-Lauge“ is produced by dissolving solid sodium hydroxide in water.
   a. How could you show, that „Brezel-Lauge“ is a solution of a hydroxide in water?
   b. Give a second possibility for producing „Brezel-Lauge“.

8. Fill in the blanks:
   Potassium (symbol ____, German name ______________) is a member of the ______________________ -family (main ________ No. I in the PSE). If you put a piece of potassium into water (no indicator present) you can observe that
   1. _____________________________________________________________
   2. _____________________________________________________________
   3. _____________________________________________________________

   In comparison with potassium, lithium is/has (use “trends in the PSE” to describe characteristics of lithium):
   1. _____________________________________________________________
   2. _____________________________________________________________
   3. _____________________________________________________________
   4. _____________________________________________________________

9. Fill out the table:

<table>
<thead>
<tr>
<th>name</th>
<th>symbol</th>
<th>flame colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>sodium</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>K</td>
<td>blue</td>
</tr>
<tr>
<td>lithium</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Assignment: Write the German terms next to the English terms!

<table>
<thead>
<tr>
<th>English Term</th>
<th>German Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>tripod</td>
<td>Stativ</td>
</tr>
<tr>
<td>Erlenmeyer flask</td>
<td>Erlenmeyer-Kolben</td>
</tr>
<tr>
<td>Petri dish</td>
<td>Petrischale</td>
</tr>
<tr>
<td>scale</td>
<td>Waage</td>
</tr>
<tr>
<td>wire mesh</td>
<td>Drahtgitter</td>
</tr>
<tr>
<td>test tube rack</td>
<td>Testtubenspender</td>
</tr>
<tr>
<td>test tube</td>
<td>Testtubus</td>
</tr>
<tr>
<td>stopper</td>
<td>Haltestopfen</td>
</tr>
<tr>
<td>spatula</td>
<td>Kämmerchen</td>
</tr>
<tr>
<td>magnifying glass</td>
<td>Lupe</td>
</tr>
<tr>
<td>filter paper</td>
<td>Filterpapier</td>
</tr>
<tr>
<td>funnel</td>
<td>Keil</td>
</tr>
<tr>
<td>glass tube</td>
<td>Glasrohr</td>
</tr>
<tr>
<td>rubber tubing</td>
<td>Schlauch</td>
</tr>
<tr>
<td>support stand</td>
<td>Ständer</td>
</tr>
<tr>
<td>clamp holder</td>
<td>Haltebügel</td>
</tr>
<tr>
<td>Bunsen burner</td>
<td>Bunsenbrenner</td>
</tr>
<tr>
<td>flame</td>
<td>Flamme</td>
</tr>
<tr>
<td>thermometer</td>
<td>Thermometer</td>
</tr>
<tr>
<td>beaker</td>
<td>Becher</td>
</tr>
<tr>
<td>measuring cylinder</td>
<td>Meßzylinder</td>
</tr>
<tr>
<td>pipette</td>
<td>Pipette</td>
</tr>
<tr>
<td>tweezers</td>
<td>Pinzette</td>
</tr>
<tr>
<td>crucible tongs</td>
<td>Trichter</td>
</tr>
<tr>
<td>magnet</td>
<td>Magnet</td>
</tr>
<tr>
<td>safety glasses</td>
<td>Sicherheitsbrille</td>
</tr>
<tr>
<td>bench</td>
<td>Tisch</td>
</tr>
<tr>
<td>periodic table of the elements</td>
<td>Periodensystem der Elemente</td>
</tr>
</tbody>
</table>
### What is good for?

**The Basic Apparatus used in Experiments with Alkali Metals**

Complete the table by stating the main function of the apparatus.

<table>
<thead>
<tr>
<th>Name of apparatus</th>
<th>Main function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. power supply</td>
<td>to set up an electric circuit in classroom</td>
</tr>
<tr>
<td>2. cable</td>
<td>to connect elements of an electric circuit</td>
</tr>
<tr>
<td>3. alligator clips</td>
<td>to connect a cable with e.g. an electrode</td>
</tr>
<tr>
<td>4. electrodes</td>
<td>to connect a solid or a liquid with the electric circuit</td>
</tr>
<tr>
<td>5. lamp in a power circuit</td>
<td>to test if something conducts electricity</td>
</tr>
<tr>
<td>6. pneumatic trough</td>
<td>to catch gases under water</td>
</tr>
<tr>
<td>7. pH-indicator</td>
<td>to detect an acidic or alkaline solution</td>
</tr>
<tr>
<td>8. test tube rack</td>
<td>to hold and store test tubes</td>
</tr>
<tr>
<td>9. test tube</td>
<td>to let small amounts of substances react with one another</td>
</tr>
<tr>
<td>10. stopper</td>
<td>to close a test tube or an Erlenmeyer flask</td>
</tr>
<tr>
<td>11. sieve spoon</td>
<td>to hold a piece of sodium safely under water</td>
</tr>
<tr>
<td>12. Bunsen burner</td>
<td>to start reactions, to heat substances</td>
</tr>
<tr>
<td>13. tripod</td>
<td>rack for heating substances with the Bunsen burner e.g. in a beaker</td>
</tr>
<tr>
<td>14. wire mesh</td>
<td>to cover the tripod so e.g. a beaker can be placed on it</td>
</tr>
<tr>
<td>15. evaporating dish</td>
<td>to evaporate a solvent like water</td>
</tr>
<tr>
<td>16. watch glass</td>
<td>to show small portions of a substance around</td>
</tr>
<tr>
<td>17. Magnesia stick</td>
<td>used for flame tests</td>
</tr>
<tr>
<td>18. spatula</td>
<td>to take substances out of the storage vessel</td>
</tr>
<tr>
<td>19. funnel</td>
<td>to pour liquids easily into a narrow vessel</td>
</tr>
<tr>
<td>20. filter paper</td>
<td>to separate solid substances from liquids</td>
</tr>
<tr>
<td>21. fume cupboard</td>
<td>to limit a person's exposure to hazardous fumes</td>
</tr>
<tr>
<td>22. Erlenmeyer flask</td>
<td>to fill in liquids</td>
</tr>
<tr>
<td>23. beaker</td>
<td>to fill in solids or liquids, for chemical reactions</td>
</tr>
</tbody>
</table>
Synthesis of Sodium Chloride

▼ SETUP

flask
chlorine gas
glass tube to place the sodium

piece of sodium
sand

▼ PROCEDURE

A small piece of sodium metal is placed in a flask containing yellow chlorine gas. The flask also contains sand to prevent the heat which will be generated by the reaction from cracking the glass. The reaction will be initiated by adding a drop of water to the sodium.

▼ OBSERVATION

Initially, no reaction is observed between the sodium and the chlorine. After the initiation with a drop of water the reaction is vigorous. A bright yellow flame occurs. A white solid substance is produced that covers the glass.

▼ CONCLUSION

Sodium and chlorine gas react to produce sodium chloride, which is the white and solid substance that covers the glass.

a) Is the reaction between sodium and chlorine endo- or exothermic?
   Give evidence from the video to support your answer.
   The reaction must be exothermic because we can see the bright flame occurring during the reaction.

b) Why was a drop of water necessary to start the reaction?
   The drop of water is needed to dissolve the coating of sodium oxide, sodium peroxide, or sodium chloride on the surface of the metal. When the oxide, peroxide, or chloride coating on the surface is dissolved, the water reacts exothermically with the sodium, raising the temperature. This probably speeds up the reaction.

Equations:

\[
\text{sodium}_{(s)} + \text{chlorine}_{(g)} \rightarrow \text{sodium chloride}_{(s)}, \text{ exothermic}
\]

\[
2 \text{Na}_{(s)} + \text{Cl}_2(g) \rightarrow 2 \text{NaCl}_{(s)}, \text{ exothermic}
\]