

## Flame Test Chart

substance	lithium compound	sodium compound	potassium compound	rubidium compound	caesium compound
colour of flame	bright red	bright orange	pale lilac	dark red	blue
liquid fertilizer colour of flame			pale lilac		
baking soda colour of flame		bright orange			
kitchen salt colour of flame		bright orange			

Fertilizer contains: potassium

Baking soda contains: sodium

Kitchen salt contains: sodium

Where alkali metals are found, too:

lithium	sodium	potassium	rubidium	caesium
fireworks, batteries, alloy for space travel, laboratory glass, medicine	fireworks, street lamps, batteries, pretzels, glass, cooling agent for nuclear reactors	matches, gunpowder, optical glass	photocells, medical research about the heart muscle	photocells, X-ray source, atomic clock, infrared lamp

### 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.

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## 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

Step 1	Step 2	Step 3	Step 4

### ▼ PROCEDURE

- Put the wood ash into a beaker and add distilled water until well covered.  
Set aside until the next Chemistry lesson.
- Filter the wood ash-water-mixture.
- Heat the filtrate (the liquid obtained by filtering) in an evaporating dish until all water has evaporated.
- 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 proves 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 19<sup>th</sup> 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!

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## Synthesis of Sodium Chloride

### Assignment

- Open the link <http://jchemed.chem.wisc.edu/jcesoft/cca/cca0/Movies/NaCl1.html> and watch the video about the synthesis of sodium chloride.
- 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.
- Answer the in your conclusion:
  - Is the reaction between sodium and chlorine endo- or exothermic? Give evidence from the video to support your answer.
  - Why was a drop of water necessary to start the reaction?
- 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.

1 – 1 – 7 – NaCl – NaOH – alkali – chlorine – cold – colourless – density – down – explosion – faster – fizzing – flame – float – floats – green – hydrogen – hydrogen – hydrogen – hydroxide – hydroxides – lithium – low – lower – melting – more – purple – sodium – soft – universal – white

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 \_\_\_\_\_ .

e. g. sodium + water \_\_\_\_\_ + \_\_\_\_\_ .

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. \_\_\_\_\_

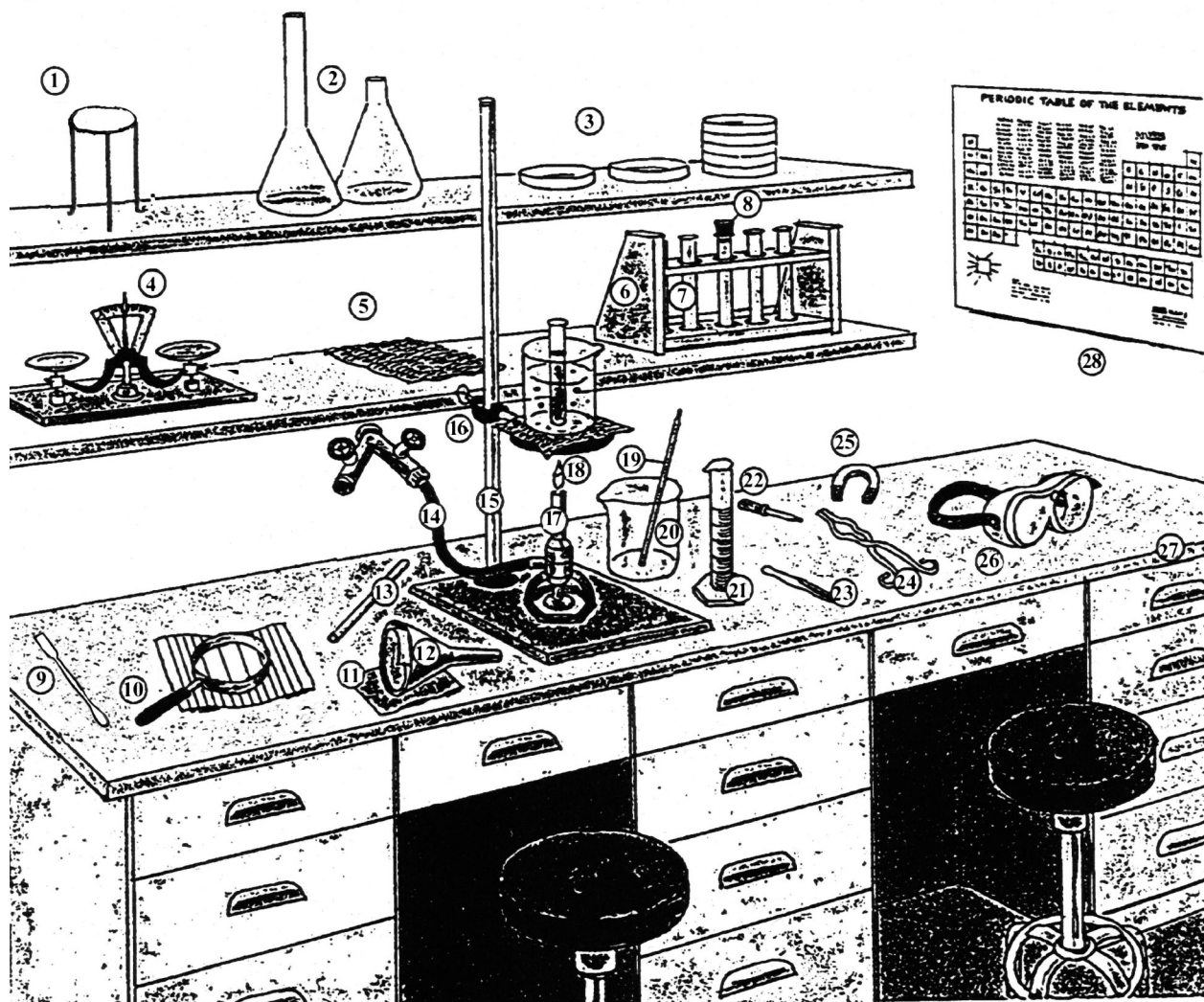
In comparison with potassium, lithium is/has (use "trends in the PSE" to describe characteristics of lithium):

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_

9. Fill out the table:

name	symbol	flame colour
sodium		
	K	
		blue
lithium		

# A Chemistry Lab



**Assignment: Write the German terms next to the English terms!**

1. tripod
2. Erlenmeyer flask
3. Petri dish
4. scale
5. wire mesh
6. test tube rack
7. test tube
8. stopper
9. spatula
10. magnifying glass
11. filter paper
12. funnel
13. glass tube
14. rubber tubing

15. support stand
16. clamp holder
17. Bunsen burner
18. flame
19. thermometer
20. beaker
21. measuring cylinder
22. pipette
23. tweezers
24. crucible tongs
25. magnet
26. safety glasses
27. bench
28. periodic table of the elements

## What is good for?

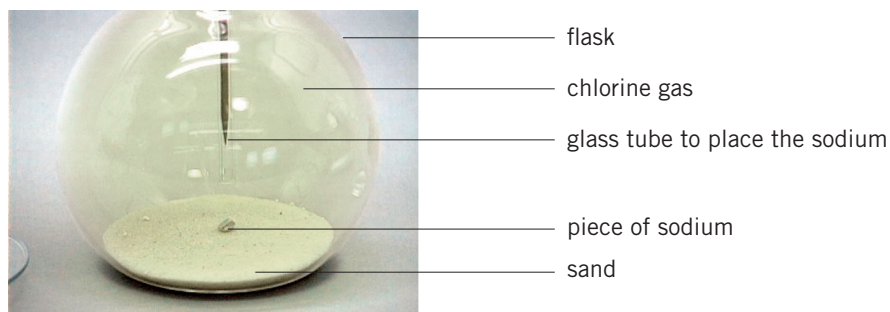
### The Basic Apparatus used in Experiments with Alkali Metals

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

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

## Synthesis of Sodium Chloride

### ▼ SETUP



### ▼ 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:

sodium<sub>(s)</sub> + chlorine<sub>(g)</sub> → sodium chloride<sub>(s)</sub>, exothermic

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