Saline solutions and their effect on various indicators

(Item No.: P7510400)

Curricular Relevance

Area of Expertise: Chemistry

Education Level: Age 14-16

Topic: Inorganic chemistry

Subtopic: Acids and bases, proton transfer

Experiment: Saline solutions and their effect on various indicators

Difficulty	Preparation Time	Execution Time	Recommended Group Size
Easy	10 Minutes	10 Minutes	2 Students

Additional Requirements:

Experiment Variations:

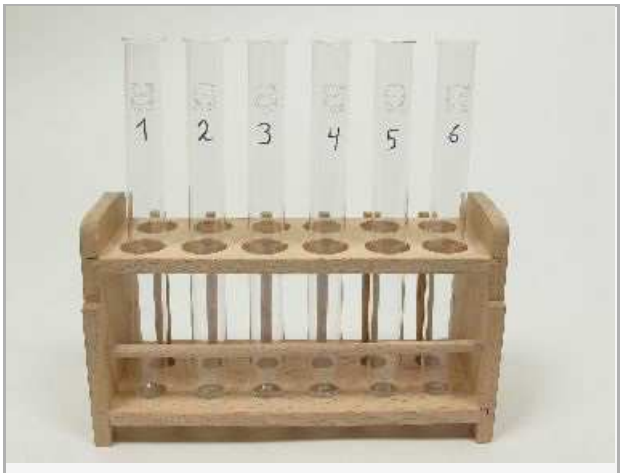
Keywords:

saline solutions, pH-value, indicator, concentration

Information for teachers

Introduction

Application
The experiment investigates the effect of saline solutions on indicators and helps to gain a better understanding of the properties of salt, especially when dissolved in water.



Experiment set-up

Educational objectives
The aim of this experiment is to show and explain to the students how indicators can be used in analytical chemistry. Furthermore, the students will find out the alkaline, acidic or neutral effects of different salts diluted in water.

Task
During this experiment, the students have to determine the pH-value of the freshly prepared saline solutions with a suitable indicator (here: universal indicator).

Prior knowledge
The students should have already gained experimental experience concerning the handling of acids and bases.

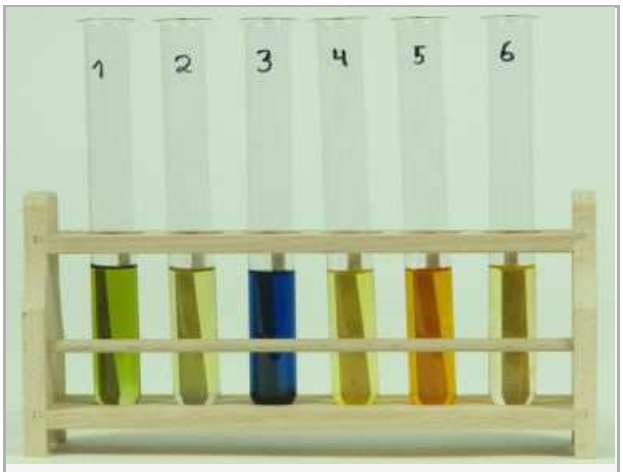
Principle
Salts are the product of an acid base neutralisation. The strength of the acid and base determines the pH-value of a salt diluted

in water. Salts of a strong base with a strong acid will produce a solution of pH = 7, in other words they are neutral (e.g. NaCl). A salt of a weak acid with a strong base will produce an alkanine solution, with a pH greater than 7. Whereas, a salt of a strong acid with a weak base will produce an acidic solution, with a pH less than 7.

Notes concerning the set-up and execution of the experiment
The prepared saline solutions do not need to be exactly concentrated but it must be ensured that the prescribed amount of water is added. The sample solution of this experiment is concentration dependent.

Disposal
After use, the solutions can be collected in the collecting tank for waste acids and bases for disposal.

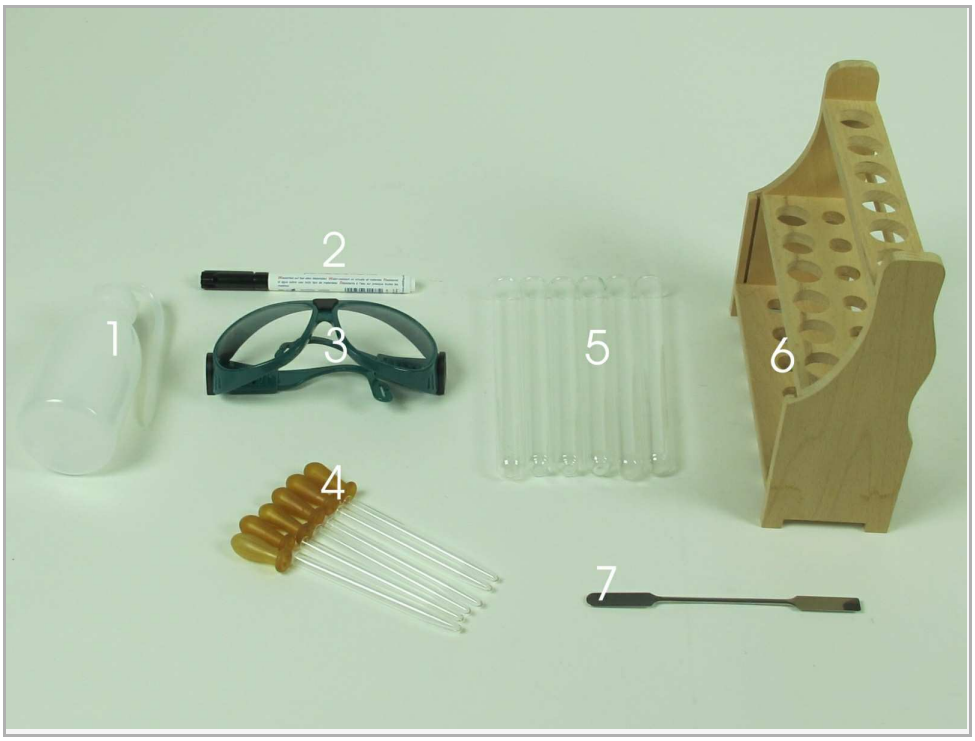
Sample Solution



Exemplary-result

Equipment

Position No.	Material	Order No.	Quantity
1	Wash bottle, 250 ml, plastic	33930-00	1
2	Laboratory pencil	38711-00	1
3	Protecting glasses, clear glass	39316-00	1
4	Pipette with rubber bulb	64701-00	3
5	Test tube, 180x18 mm, 100 pcs	37658-10	(6)
6	Test tube rack f. 6 tubes, wood	37685-10	1
7	Double spatula, steel, l = 150 mm	33460-00	1
	Ammonium chloride, 250 g	30024-25	
	Potassium carbonate, 98-100%, 250 g	30096-25	
	Potassium nitrate, 250 g	30106-25	
	Sodium acetate trihydrate, 250 g	30149-25	
	Sodium chloride, 250 g	30155-25	
	Aluminium chloride, 250 g	31017-25	
	Water, distilled, 5 l	31246-81	
	Methyl orange soln., 0.1%, 250 ml	31573-25	
	Liquid indicator pH1-13 UNISOL113	47014-02	
	Bromothymol blue, 0.1% sol. 5 ml	48004-05	



Safety information

Hazard and precautionary statements

Potassium carbonate	
H315:	Causes skin irritation.
H319:	Causes serious eye irritation.
P302 + P352:	IF ON SKIN: Wash with plenty of soap and water.
P305 + P351 + P338:	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
Aluminium chloride	
H315:	Causes skin irritation.
H319:	Causes serious eye irritation.
P280:	Wear protective gloves/protective clothing/eye protection/face protection.
P305 + P351 + P338:	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do – continue rinsing.
P302 + P352:	IF ON SKIN: Wash with plenty of soap and water.
Ammonium chloride	
H302:	Harmful if swallowed.
H319:	Causes serious eye irritation.
P305 + P351 + P338:	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
Potassium nitrate	
H272:	May intensify fire; oxidiser.
P220:	Keep/Store away from clothing/…/combustible materials.
Universal indicator	
H225:	Highly flammable liquid and vapour.
P210:	Keep away from heat/sparks/open flames/hot surfaces. No smoking.
P233:	Keep container tightly closed.
P370 + 378:	In case of fire: Use all extinguisher media to extinguish.
P403 + 235:	Store in a well-ventilated place. Keep cool.

Hazards

- Acids and bases have a strong irritating effect!
- Wear protective glasses!

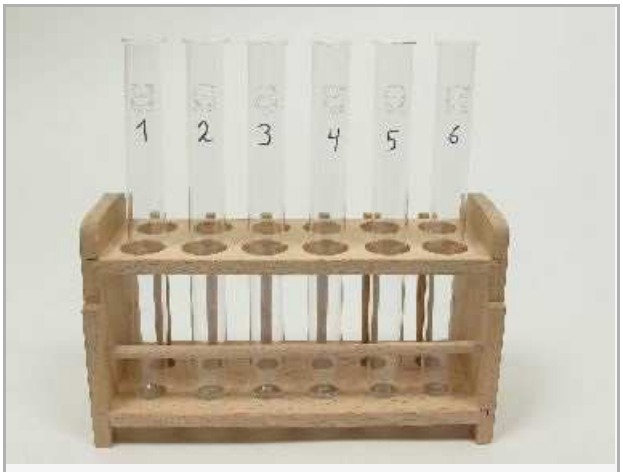
Saline solutions and their effect on various indicators **(Item No.: P7510400)**

Introduction

Application and task

Why are saline solutions alkaline, acidic or neutral?

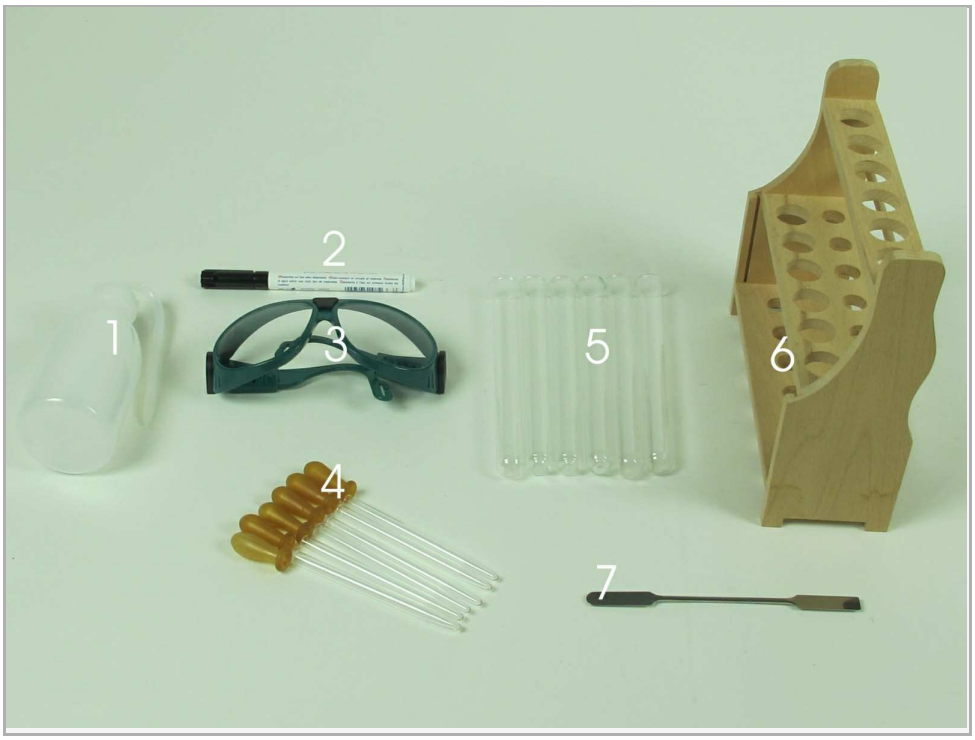
Application
It is known that the product of a neutralisation is water and salt. The pH-value of the solution is neutral.
However, some salts, when dissolved in water, produce an alkaline or acidic solution. Even in our every day life we encounter the properties of salts. Every hobby gardener knows that an acid soil stops plants from growing, therefore they add calcium carbonate, an alkaline salt, to deacidify the soil.



Experimental setup

Task
Determine the pH-value of the prepared saline solutions with an universal indicator, bromothymol blue and methyl orange.

Equipment



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	Liquid indicator pH1-13 UNISOL113	47014-02	
	Bromothymol blue, 0.1% sol. 5 ml	48004-05	

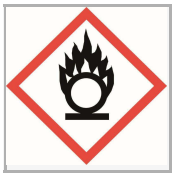
Set-up and procedure

Set-up

Hazards

- The salts required for this experiment are partly hazardous to health. Do not swallow them!
- Wash your hands thoroughly after the experiment!
- Put on protective glasses!






Set-up
Number the test tubes from 1 to 6 (Fig. 1).

Fig. 1

Put the test tubes next to each other into the test tube rack (Fig. 2).

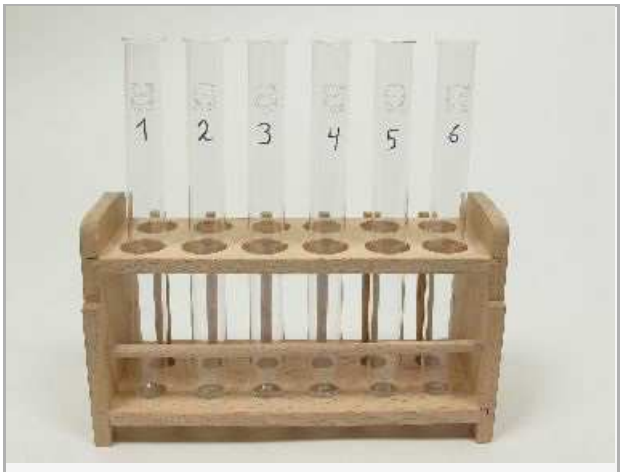


Fig. 2

Procedure

Procedure
Fill a spatula-tipfull of sodium carbonate into test tube 1 (Fig. 3) and a spatula-tipfull of the other salts listed into the other test tubes. Fill the test tubes one third full with distilled water (Fig. 4).

1. Sodium acetate
2. Sodium chloride
3. Potassium carbonate
4. Aluminium chloride
5. Ammonium chloride
6. Potassium nitrate

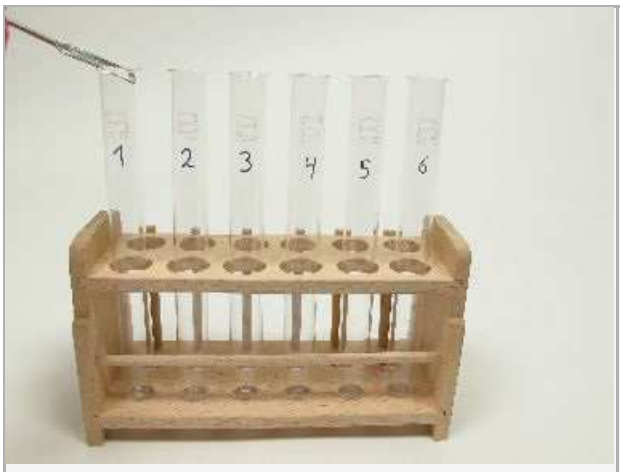


Fig. 3

Fig. 4

Dissolve the salts (if necessary, by shaking the test tubes vigorously), then add some drops of the universal indicator solution to teast tube 1 and 2. Add a few drops of bromothymol blue to test tubes 3 and 4. And then add some drops of methyl orange to test tubes 5 and 6 (Fig. 5).

Fig. 5

Use the reference strips to determine the pH-value of each saline solution and enter the values into Table 1.

Disposal
Put the content of all the test tubes into the collecting tank for acids and alkalis.

Report: Saline solutions and their effect on various indicators

Result - Table 1

Complete the table below.

Test tube	Salt	Colour		alkaline/acidic reaction	
1	Sodium acetate	green	1	alkaline	1
2	Sodium chloride	bright yellow	1	neutral	1
3	Potassium carbonate	blue	1	alkaline	1
4	Aluminium chloride	bright yellow	1	acidic	1
5	Ammonium chloride	bright orange	1	acidic	1
6	Potassium nitrate	bright yellow	1	neutral	1

Evaluation - Question 1

Salts dissociate in water, i.e. the salt's components (anions and kations) are disassembled. Complete the equations below.
Please note: Ions have a charge, therefore use the symbols ± .

Sodium chloride:

..... (s) → ..... (aq) + ... (aq)

Sodium acetate:

..... (s) → ..... (aq) + ... (aq)

Ammonium chloride:

..... (s) → ..... (aq) + ... (aq)

Evaluation - Question 2

In Question 1 you completed the equations for the dissociation of the salts sodium chloride, sodium acetate and ammonium chloride. Explain why the salts produce an alkaline, acidic or neutral solution.

1. Sodium chloride
2. Sodium acetate
3. Ammonium chloride

.....

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Evaluation - Table 2

Salts are a product of the neutralisation of an acid and a base. The key factor for the pH-value of saline solutions is the strength of the acid and base used in the neutralisation.

Complete the table below and determine which acids or bases have been used to produce each of the salts and whether they are strong or weak.

Salt	Acid		strong/weak		Base		strong/weak	
Sodium acetate	Acetic acid	1	weak	1	Sodium hydroxide	1	strong	1
Sodium chloride	Hydrochloric acid	1	strong	1	Sodium hydroxide	1	strong	1
Potassium carbonate	Carbonic acid	1	weak	1	Potash lye	1	strong	1
Aluminium chloride	Hydrochloric acid	1	strong	1	Aluminium hydroxide	1	weak	1
Ammonium chloride	Hydrochloric acid	1	strong	1	Ammonium hydroxide	1	weak	1
Potassium nitrate	Nitric acid	1	strong	1	Potash lye	1	strong	1

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