Hydrolysis of salts (Item No.: P7159800)

Curricular Relevance

Area of Expertise: Chemie
Education Level: Klasse 7-10
Topic: Anorganische Chemie
Subtopic: Salze
Experiment: Hydrolyse von Salzen

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

Additional Requirements:

Experiment Variations:

Keywords:

salts, material property, hydrolysis

Task and equipment

Information for teachers

Learning objectives

- Though salts are obtained from a neutralisation, they don't always react neutral in the form of an aqueous solution.
- The reaction of salts depends on how strong or weak the acids and alkalis are which they are obtained from.

Notes on set-up and procedure

Preparations
Have the universal indicator and especially a sufficient number of colour comparison scales ready.

Remarks on the students' experiments
It is not necessary for the saline solutions to have all the same concentration though the exact quantity of water to be added should be observed. The pH-values given in Table 1a depend on the concentration.

Hazard and Precautionary statements

Potassium carbonate:	
H315:	Causes skin irritation.
H319:	Causes serious eye irritation.
H335:	May cause respiratory 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 minuts. Remove contact lenses, if present and easy to do. Continue rinsing.
Potassium nitrate:	
H272:	May intensify fire; oxidizer.
P210:	Keep away from heat/sparks/open flames/hot surfaces. – No smoking.

Ammonium chloride:	
H302:	Harmful if swallowed.
H319:	Causes serious eye irritation.
P305 + P351 + P338:	IF IN EYES: Rinse cautiously with water for several minuts. Remove contact lenses, if present and easy to do. Continue rinsing.
Aluminium chloride:	
H314:	Causes severe skin burns and eye damage.
P280:	Wear protective gloves/protective clothing/eye protection/face protection.
P305 + P351 + P338:	IF IN EYES: Rinse cautiously with water for several minuts. Remove contact lenses, if present and easy to do. Continue rinsing.
P310:	Immediately call a POISON CENTER or doctor/physician.

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!

Notes

When salts originating from acids and alkalis of different strength react with water, different equilibriums are established which are actually responsible for the pH-value.

Aluminium chloride, for instance, forms hydrated aluminium ions and chloride ions in water. Chloride ions can be regarded as being the anion of hydrochloric acid which is completely dissociated and thus does not change the concentration of hydronium ions of the water. The aluminium ion reacts in a different way: Since aluminium hydroxide is only very slightly dissociated, the aluminium cation reacts with the hydroxide ions to form undissociated aluminium hydroxide. Since in this case the hydroxide ions are withdrawn from the protolytic equilibrium, new hydroxide ions and thus also hydronium ions must be formed in order to re-establish the equilibrium. As a consequence, the concentration of hydronium ions increases. That is why the equilibriums must be compared:

$$\frac{\mathrm{Me^+ \cdot OH^-}}{\mathrm{MeOH}} = K \text{ und } \mathrm{H_3O^+ \cdot OH^-} = 10^{-14}$$

Remarks on the method

Depending on the level of knowledge of the students the protolytic processes taking place when salts are dissolved can be treated in a more or less complex way. In the easiest case the whole subject can be reduced to the strength of the corresponding acids and alkalis. However, this experiment is also suitable for a complex treatment of the equilibriums.

Waste disposal

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

Robert-Bosch-Breite 10
D - 37079 Göttingen
Tel: +49 551 604 - 0
Fax: +49 551 604 - 107
info@phywe.de
www.phywe.com

Hydrolysis of salts (Item No.: P7159800)

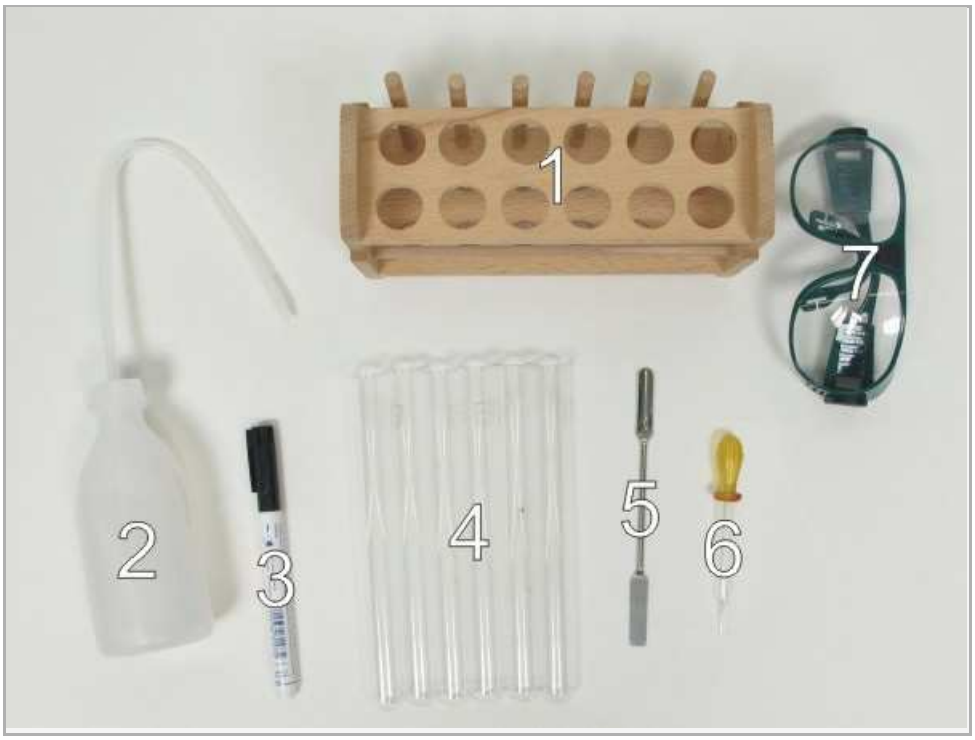
Task and equipment

Task

Do aqueous saline solutions react neutral?

Prepare several saline solutions and study their pH-value.

Equipment



Position No.	Material	Order No.	Quantity
1	Test tube rack for 12 tubes, holes d= 22 mm, wood	37686-10	1
2	Wash bottle, 250 ml, plastic	33930-00	1
3	Labor pencil, waterproof	38711-00	1
4	Test tube, 18x188 mm, 10 pcs	37658-03	(6)
5	Spatula, powder, steel, l=150mm	47560-00	1
6	Pipette with rubber bulb	64701-00	1
7	Protecting glasses, clear glass	39316-00	1
	Ammonium chloride 250 g	30024-25	1
	Potassium carbonate,98-100% 250 g	30096-25	1
	Potassium nitrate 250 g	30106-25	1
	Sodium acetate trihydrate, 250 g	30149-25	1
	Sodium chloride 250 g	30155-25	1
	Aluminium chloride 250 g	31017-25	1
	Water, distilled 5 l	31246-81	1
	Liquid Indicator pH1-13 UNISOL113	47014-02	1

Robert-Bosch-Breite 10
D - 37079 Göttingen
Tel: +49 551 604 - 0
Fax: +49 551 604 - 107
info@phywe.de
www.phywe.com

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).

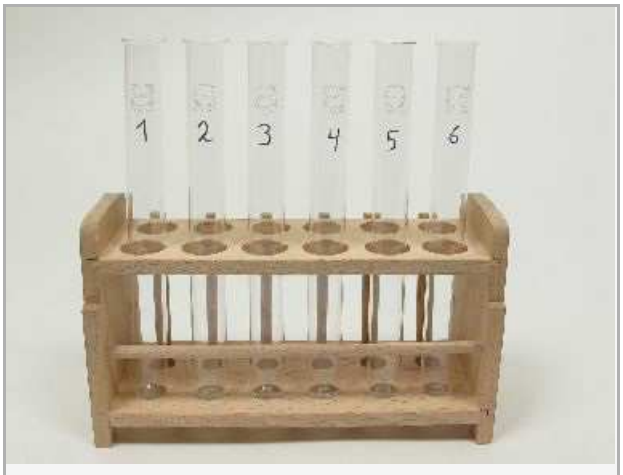


Fig. 2

Procedure

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).

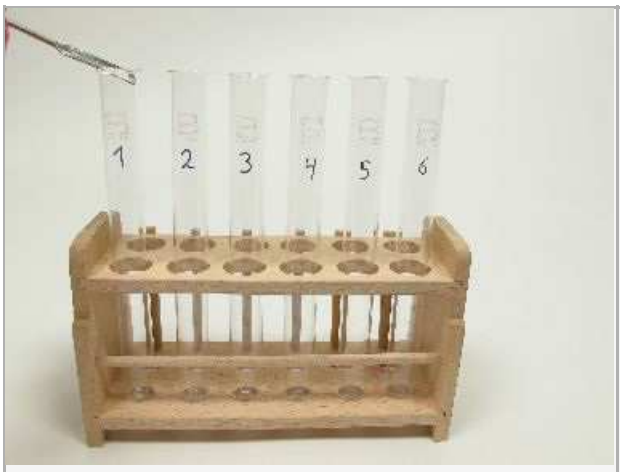


Fig. 3

Fig. 4

Dissolve the salts (if necessary, by shaking the test tubes vigorously), then drop some drops of the universal indicator solution into each test tube (Fig. 5).

Fig. 5

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

Waste disposal

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

Report: Hydrolysis of salts

Result - Table 1

Enter the pH-values determined into Table 1.

Test tube	Dissolved salt	pH value	Acid/basic reaction
1	Sodium acetate	$^{1}_{\pm 0}$	basic 1
2	Sodium chloride	$^{1}_{\pm 0}$	neutral 1
3	Potassium carbonate	$^{1}_{\pm 0}$	basic 1
4	Potassium nitrate	$^{1}_{\pm 0}$	neutral 1
5	Ammonium chloride	$^{1}_{\pm 0}$	acid 1
6	Aluminium chloride	$^{1}_{\pm 0}$	acid 1

Evaluation - Question 1

Give a reason for what pH-value could have been actually expected.

.....

.....

.....

.....

Robert-Bosch-Breite 10
D - 37079 Göttingen

Tel: +49 551 604 - 0
Fax: +49 551 604 - 107

info@phywe.de
www.phywe.com

Evaluation - Question 2

By means of a neutralisation of what acids and alkalis could the salts stated below be obtained?

State in the table whether the acids and alkalis are weak or strong ones.

Salt	Acid	Strong/weak	Alkali	Strong/weak
Sodium acetate	Acetic acid	weak	sodium hydroxide solution	strong
Sodium chloride	Hydrochloric acid	strong	sodium hydroxide solution	strong
Potassium carbonate	Carbonic acid	weak	potassium hydroxide soluti	strong
Potassium nitrate	Nitric acid	strong	potassium hydroxide soluti	strong
Ammonium chloride	Hydrochloric acid	strong	ammonia solution	weak
Aluminium chloride	Hydrochloric acid	strong	aluminium hydroxide solut	weak

Evaluation - Question 3

Try to find a reason for the reaction behaviour on the basis of this statement.

.....

.....

.....

.....