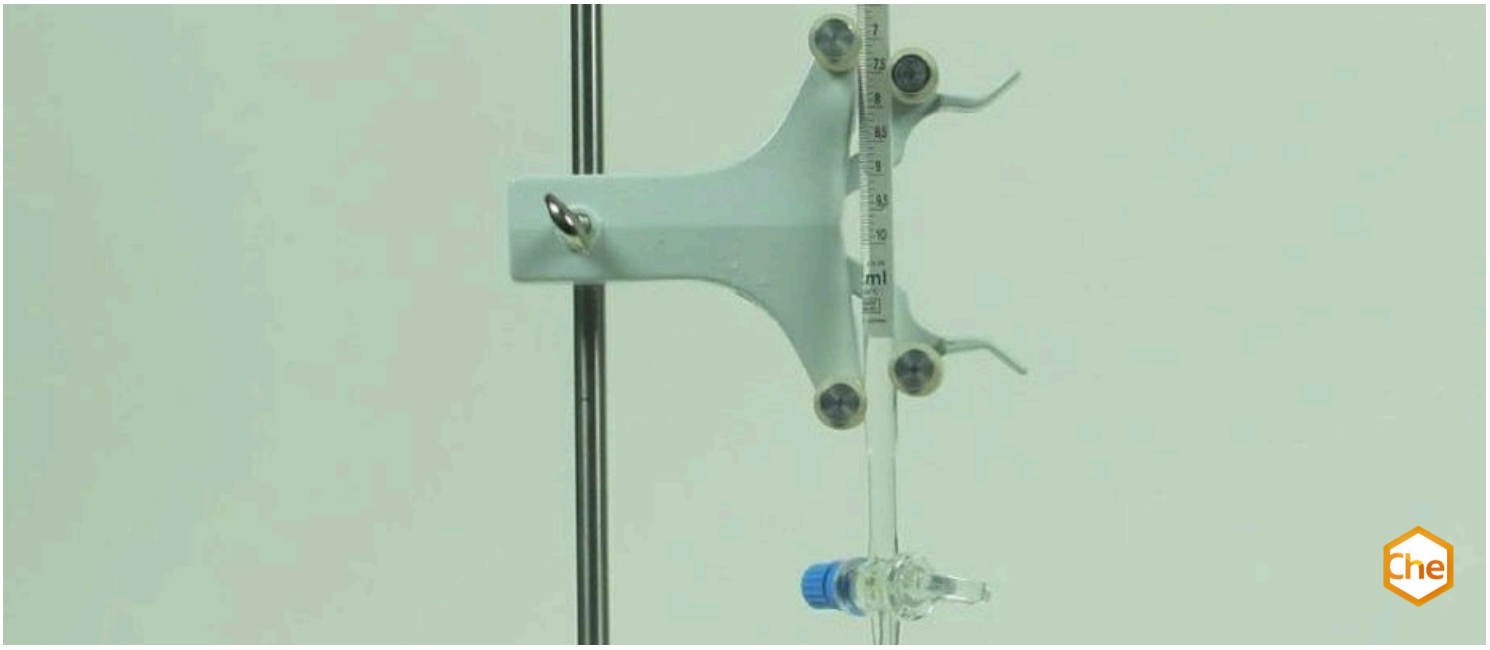
Determination of chloride by Fajans



Chemistry > Inorganic chemistry > Acids, bases, salts

Difficulty level	Group size	Preparation time	Execution time
medium	2	10 minutes	30 minutes

This content can also be found online at:

http://localhost:1337/c/638ba12b1df5f8000302f3ac

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Teacher information

Application

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Experimental setup

The (direct) titration according to Fajans is a method for the quantitative determination of chloride. It belongs to the Argentometry. A special indicator, a so-called adsorption indicator, is used.

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Other teacher information (1/3)

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Prior knowledge

Principle

The functioning of volumetric measuring instruments (graduated pipette, burette, pipetting ball) should be known to the students.

This (direct) titration is a measurement-analytical method for determining the concentrations of chloride.

Organic dyes, in this case fluorescein, are used as (adsorption) indicators. The solution to be determined should be neutral, as the indicator only leads to the desired change in the anionic form.

When titrating with silver nitrate, the known reaction to silver chloride (white precipitate) occurs first. After reaching the equivalence point, the silver added as an excess is adsorbed to the silver chloride precipitate, resulting in a positive charge of the complex. The now positively charged complex attaches itself to the anionic part of the indicator, resulting in a "deformation" of the dye. The solution changes from yellow to pink.

Other teacher information (2/3)

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Learning objective

The students should be shown and taught, by way of example, the use of adsorption indicators in analytical chemistry as well as the basics of dimensional analysis.

Tasks

The students are to determine the initially unknown concentration of a 0.1 M sodium chloride solution (analysis solution) with the help of an adsorption indicator (here: fluorescein). A known volume of this solution is titrated with a volume of a silver nitrate solution of known concentration (standard solution, 0.1 M) until the indicator changes colour. The concentration of the analysis solution is then calculated from the consumed volume of the standard solution and its concentration.

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Other teacher information (3/3)

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Notes on set-up and procedure

When setting up, make sure that the burette is attached to the stand in such a way that the students can accurately read the height of the liquid column.

The dripping speed of the burette should not be set too fast so that the result is as accurate as possible. It is also important to avoid dripping too slowly, otherwise the experiment would be unnecessarily prolonged.

Disposal

Reagents that are not used in other analyses and cannot be passed on must be disposed of. Solutions containing silver must not be neutralised. They are to be disposed of in a specially designated container. All other solutions are to be adjusted to a pH of 8-10 with technical sodium carbonate and then disposed of in the container for acids and bases waste.

Result

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The figure on the right shows the sample result of the experiment:

- Left: Before the titration
- Right: After the turnover point

Sample result

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Safety instructions

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- Acids and bases cause severe burns.
- Use protective goggles/gloves!
- The general instructions for safe experimentation in science lessons apply to this experiment.
- For H and P phrases, please refer to the safety data sheet of the respective chemical.

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Student information

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Application and task

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Experimental setup

How can you determine the concentration of chloride in a solution?
In everyday life and in the chemistry lab you have certainly encountered chloride. For example, in the form of NaCl, the table salt on your breakfast egg. In chemistry, chloride is also used as a halide for things other than breakfast eggs. Here it is important, among other things, to determine the exact concentration of chloride.

With the help of a suitable indicator and silver nitrate, one can determine the concentration of chloride. This procedure is called direct titration.

Task
Determine the concentration of chloride with the help of a titration. Use fluorescein as the indicator and a 0.1 molar silver nitrate solution as the titration solution. Note the volume value (of silver nitrate solution) at the transition point.

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Equipment

Position	Material	Item No.	Quantity
1	Burette with straight stopcock, 25 ml Graduation 0.1 ml	47153-01	1
2	Pipette with rubber bulb	64701-00	1
3	Erlenmeyer flask, Borosilicate, wide neck, 100 ml	46151-00	1
4	Funnel, diameter = 100 mm, plastic (PP)	36891-00	1
5	Graduated pipette, 5 ml : 0,1	36599-00	1
6	Protecting glasses, clear glass	39316-00	1
7	Pipettor,bulb,3 valves,100ml max.	47127-02	1
8	Burette clamp, roller mount.,1pl.	37720-01	1
9	Support base, variable	02001-00	1
10	Support rod, stainless steel, l=370 mm, d=10 mm	02059-00	1
11	Wash bottle, 250 ml, plastic	33930-00	1
12	Laboratory pen, waterproof, black	38711-00	1
13	Sodium chloride 250 g	30155-25	1
14	Water, distilled 5 l	31246-81	1
15	Silver nitrate solution 5% 100 ml	30223-10	1
16	Ethyl alcohol, absolute 250 ml	30008-25	1
17	Fluorescein 25 g	31314-04	1
18	Beaker, 50 ml, plastic (PP)	36080-00	2

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Set-up (1/6)

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1. Put the two halves of the stand foot together (**Fig. 1**).
2. Attach the stand rod to the stand foot (**Fig. 2**).
3. Attach the burette clamp to the stand rod (**Fig. 3**).

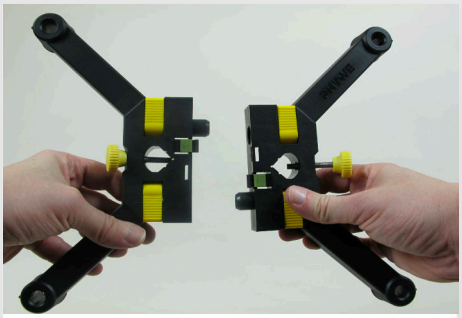

Fig. 1

Fig. 2

Fig. 3

Set-up (2/6)

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Press the two levers of the burette clamp together with your thumb and forefinger (**Fig. 4**) and place the burette between the four rubberised rollers (**Fig. 5**). Fix the burette by slowly releasing the two levers.

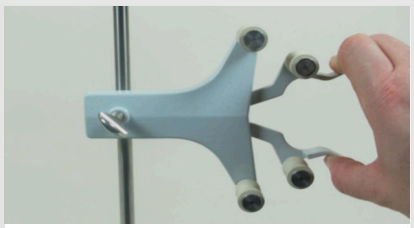

Fig. 4

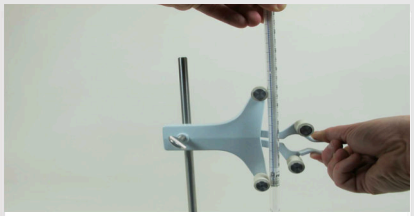

Fig. 5

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Set-up (3/6)

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Fill the burette with the 0.1 molar silver nitrate solution using the funnel. Use the two laboratory beakers and label them to avoid any risk of confusion.

Carefully fill the 10 ml burette to above the upper calibration mark. Make sure that there are no air bubbles in the burette and that nothing is overflowing (**Fig. 6**).

Place one of the laboratory beakers under the tap of the burette and open it carefully. Drain as much silver nitrate solution as necessary until the top calibration mark of the liquid column is reached (**Fig. 7**).

Fig. 6

Fig. 7

Set-up (4/6)

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A downward curvature forms on the surface of the liquid column in the burette, the so-called meniscus (Greek meniskos = half moon). To measure exactly when the liquid column touches the top of the burette, orientate yourself to the lowest point of this curvature. Your eyes should be exactly at the level of the calibration line (**Fig. 8**).

Place the pipetting ball on the graduated pipette (**Fig. 9**). Press the valve "A" together with your thumb and index finger. Press air out of the pipetting ball with the other fingers (**Fig. 10**).

Fig. 8

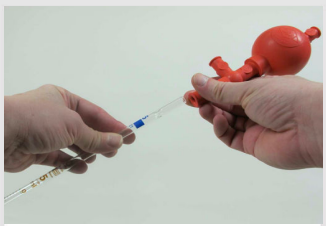

Fig. 9

Fig. 10

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Set-up (5/6)

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Hold the pipette vertically and insert its tip into the prepared sodium chloride solution of unknown concentration. By carefully squeezing the valve "S", the pipette slowly fills with the solution. Make sure that the pipette does not fill too quickly. There must be no air bubbles in the liquid. Caution: No solution should get into the pipetting ball!

Fill the graduated pipette to about six millilitres (**Fig. 11**).

Squeeze the valve "E" and let as much solution run out of the graduated pipette until there is exactly 5 ml of liquid in it (**Fig. 12**).

The reading of the filling level is done here as described above.

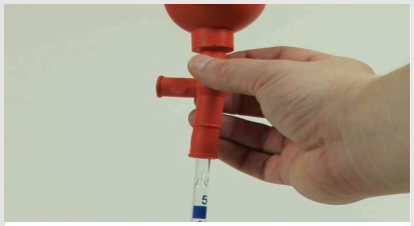

Fig. 11

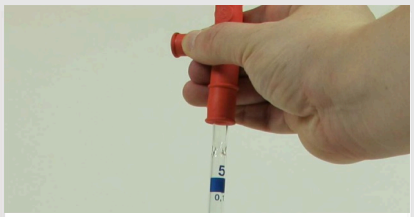

Fig. 12

Set-up (6/6)

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Fig. 13

Carefully remove the graduated pipette from the sodium chloride solution and insert it into the Erlenmeyer flask. Squeeze the valve "E" to empty it completely into the vessel (**Fig. 12**).

A small drop remains in the tip of the graduated pipette when it runs out. This has already been taken into account when calibrating the pipette so that it does not have to be removed from the pipette.

Repeat this procedure so that there is 10 ml of sodium chloride solution in the conical flask. Dilute the sodium chloride solution with 15 ml distilled water. water.

Add 3 to 5 drops of the 2% fluorescein to the sodium chloride solution (**Fig. 13**).

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Procedure (1/2)

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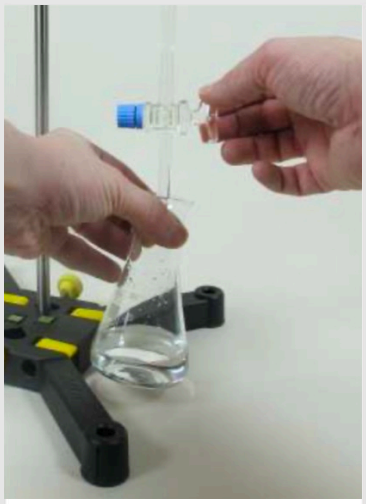

Fig. 14

Set a medium drip speed by carefully turning the burette tap.

It must be possible to observe individual drops.

Swirl the Erlenmeyer flask with the sodium chloride solution carefully back and forth (**Fig. 14**). No splashes should be allowed to form.

Reduce the dripping speed by carefully turning the burette tap as soon as a colour change in the acid solution becomes apparent.

Close the burette tap after the first drop where the colour change remains permanent.

Read off the volume of silver nitrate solution consumed from the burette and note it down as well as the change in colour.

Procedure (2/2)

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Disposal

Reagents that are not used in other analyses and cannot be passed on must be disposed of. Solutions containing silver must not be neutralised. They are to be disposed of in the containers specially provided for this purpose. All other solutions are to be adjusted to a pH value of 8-10 with technical sodium carbonate and then disposed of in acid-base waste.

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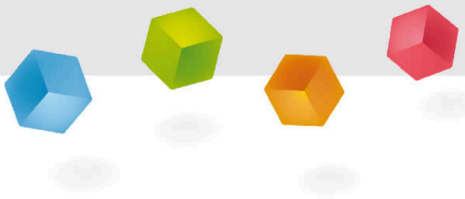

Report

Observation

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Write down your observations.

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Task 1

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Think about the reaction equation of silver nitrate and sodium chloride. What can you recognise from it?

Task 2

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What is the chloride concentration of the sodium chloride solution?

(With the knowledge from question 1 you can determine the concentration of chloride).

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Task 3

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Drag the terms into the correct gaps in the text.

At the equivalence point of this experiment, the resulting _____ of _____ attaches itself to the _____ and charges them _____. The _____ charged anions of the dye fluorescin attach themselves to these and change its molecular structure, which then leads to the _____.

positively
silver chlorides
negatively
silver ions
surplus
colour change

Check

Task 4

PHYWE

Drag the terms into the correct gaps in the text.

The mass concentration _____ is the _____ of the mass _____ of a dissolved substance and the _____ of the solution. The unit of the amount of substance concentration is _____, that of the amount of substance is _____.

(c)
mol/L
quotient
mol
(n)
volume (V)

Check

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Task 5

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Which substance becomes visible as a white precipitate in the first reaction?

- ○ Silver nitrate
- ○ Silver chloride
- ○ Fluorescin

Check

Chemistry lab

Slide	Score / Total
Slide 23: Equivalence point	0/6
Slide 24: Substance concentration	0/6
Slide 25: White precipitation	0/1

Total 0 / 13

Solutions | Repeat | Export text

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