

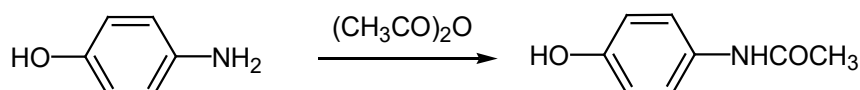
## Title: Preparation of paracetamol

### Work instructions

**Task:** Prepare 4-hydroxyacetanilide (paracetamol) by acetylation of 4-aminophenol.

### Theory

Acetylation of 4-aminophenol is the addition-elimination reaction of an aromatic amine with acetic anhydride to form paracetamol according to Eq:



**Equipment:** boiling flask (100 ml), magnetic stirrer with stir bar, graduated cylinder, reflux condenser, cooling water inlet and outlet hose, Büchner funnel, rubber adapter, suction flask, water jet pump, funnel, filter paper, beaker, laboratory stand

**Chemicals:** 4-aminophenol, acetic anhydride

### Procedures:

1. All work is carried out with safety goggles!

#### *Acetylation of 4-aminophenol*

1. Mix 2.1 g of 4-aminophenol with 18 ml of water in a 100 ml flask with a stir bar and add 3 ml of acetic anhydride to the suspension. Place a reflux condenser on the flask and reflux the reaction mixture for 15 min with stirring.
2. Cool the flask in ice-water, aspirate the solid that has fallen out on a Büchner funnel, wash with cold water and dry the raw product by suction.

#### *Crystallisation of paracetamol*

1. Add a small quantity of water to the raw paracetamol in the boiling flask, fit a reflux condenser and bring the suspension to the boil. In small batches, add water through the condenser until a saturated boiling solution is formed. When hot, filter it through a folded paper filter. Cool the filtrate, aspirate the precipitated crystals on a Büchner funnel and dry.

## Management of chemical substances

Chemicals	Form	H-statements	P-statements
4-Aminophenol	Solid, raw	H301, H301 + H311 + H331, H311, H331, H373	P261, P273, P280, P301 + P310, P311
Acetic anhydride	Liquid, 99%	H226, H302, H314, H332	P280, P305 + P351 + P338, P310

## Sources of risk and assessment of risk severity

There is no risk when following all the principles for working with chemicals and using personal protective equipment (gloves, goggles, lab coat).

## Waste management method

Dispose of waste materials in a marked container. Do not return unconsumed residues to storage bottles. Dispose of broken glass in a marked container.

## Risk reduction measures

Avoid direct exposure, use protective equipment. Do not expose to prolonged or repeated exposure. In the event of an accident or if you feel unwell, inform the teacher immediately. These substances or their containers must be disposed of as hazardous waste. Do not eat, drink, smoke. Wash your hands with warm water and soap or treat them with a reparative cream after work or when interrupting work.

## Worksheet

### Calculations

- Calculate the theoretical yield of paracetamol ( $C_8H_9NO_2$ ).  
 $M(C_6H_7NO) = \dots\dots\dots \text{ g.mol}^{-1}$ ,  $M(C_8H_9NO_2) = \dots\dots\dots \text{ g.mol}^{-1}$

- Calculate the practical yield of paracetamol v %.

PV =  $\dots\dots\dots$  g, TV =  $\dots\dots\dots$  g

PV(%) =  $\dots\dots\dots$  %

### Observation

- Describe the appearance and smell of paracetamol.
- Search for the basic physicochemical properties of paracetamol.

Feature	Description
Solubility in water	
Solubility in other solvents	
Melting temperature	

### Yield

- Record the mass of paracetamol prepared.

$m(C_8H_9NO_2) = \dots\dots\dots$  g

**Name of the project:** Digitization of chemistry experiments to improve the quality and support chemistry teaching in secondary schools  
**Acronym:** ChemIQSoc  
**Project number:** 2021-1-SK01-KA220-VET-000027995



## Questions

1. Write the equation of the reaction for the preparation of paracetamol.
2. Draw the apparatus you used in the preparation of paracetamol. You can also draw the apparatus using specialised software, e.g. ChemSketch.
3. Explain the function of the reflux condenser in the synthesis of paracetamol.
4. Indicate how you would determine the purity of the product obtained.
5. Analyze the factors that can reduce the yield of the reaction.
6. Suggest how to increase the purity of synthesized paracetamol.
7. State the practical significance of this synthesis and its industrial applications.

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## **Conclusion**

Briefly summarize the objective of the experiment, the main results and compare them with the expected values.

## **Disclaimer**

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