

# Autocatalysis

## Equipment:

2 goblets (conical cups)  
2 beakers (50 mL)  
2 beakers (100 mL)  
2 glass rods  
measuring cylinders

## Chemicals:

potassium permanganate solution (0.1 M)  
oxalic acid solution (0.5 M)  
sulfuric acid (4 M)  
deionized water  
manganese(II) chloride

## Safety:

potassium permanganate (KMnO<sub>4</sub>):



H272, H302, H410  
P210, P273

oxalic acid (H<sub>2</sub>C<sub>2</sub>O<sub>4</sub>):



H302 + H312  
P262, P302 + P352

sulfuric acid (H<sub>2</sub>SO<sub>4</sub>):



H290, H314  
P301 + P330 + P331, P305 + P351 + P338

manganese(II) chloride (MnCl<sub>2</sub>)



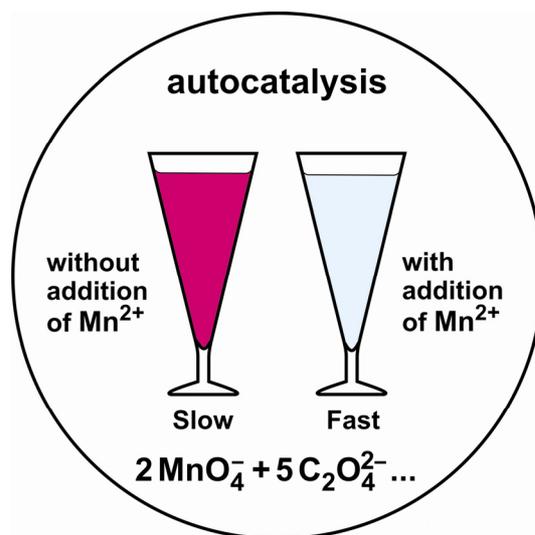
H301, H412  
P271, P301 + P310

It is necessary to wear safety goggles and protective gloves, because every contact with eyes or skin should be avoided.

## Procedure:

Preparation: 15 mL of oxalic acid solution and 30 mL of sulfuric acid are poured into each of the two goblets. 15 mL of potassium permanganate solution are filled into each of the 50-mL beakers, 60 mL of deionized water into each of the 100-mL beakers. A spatula-tip full of manganese chloride is then added to the water in one of the beakers.

Procedure: First, the potassium permanganate solution along with the pure water is poured into the first goblet. Subsequently, the same amount of potassium permanganate solution is added rapidly to the second goblet together with the water enriched with Mn<sup>2+</sup> ions. Both solutions are stirred.

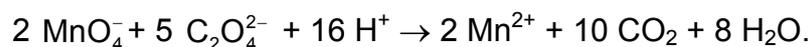


**Observation:**

The solutions decolorize from violet to wine red and then yellow-brown until they are colorless. At the same time, some bubble formation due to the generation of carbon dioxide can be observed. But the decolorization process begins immediately in the second goblet, whereas the decolorizing appears only after approx. 2 min in the first goblet. The reaction in the first goblet initially proceeds slowly, but the rate gradually increases.

**Explanation:**

Purple permanganate ions are reduced in acidic solution by oxalate ions to the nearly colorless manganese(II) ions, whereas the oxalate ions are oxidized to gaseous carbon dioxide:



Obviously, the  $\text{Mn}^{2+}$  ions act as catalyst. The reaction rate increases gradually even when no  $\text{Mn}^{2+}$  ions are added because they are formed during the reaction meaning this product autocatalyzes its own formation.

**Disposal:**

The solutions are poured into the container for heavy-metal waste.