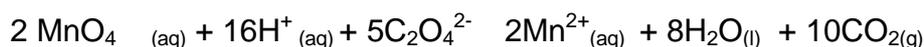


# Investigating the rate of reaction between manganate(VII) ions and oxalate ions

## Background

Reactions between similarly charged ions often proceed at a rate, which can be measured. The reaction between manganate(VII) ions and oxalate (ethanedioate) ions is one such reaction.



The rate can be measured by finding the time taken for the purple colour of the manganate(VII) ions to disappear. Any brown suspension is ignored. You can follow the rate of the reaction by simply recording the time for the purple colour to disappear or you could use a colorimeter. (You would need to calibrate the colorimeter with a series of solutions of known concentrations of manganate(VII) ions).

## Practical Techniques

You will need to find out about how to make up accurate solutions and how to use a colorimeter.

## Where to start

You need to plan a series of experiments to vary the concentrations of the reactants to investigate their effect on the rate of the reaction. You will be able to find the order of reaction for each reactant and hence the rate equation for the reaction.

## Possible Investigations

- Investigate the reaction at different temperatures to determine the effect of temperature on the rate and hence determine the activation enthalpy for the reaction.
- Investigate the effect of manganese (II) ions on the reaction -what is the catalytic effect?
- Investigate a different technique for monitoring the rate of the reaction – one possibility is conductivity.

## Sources of Information

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- <http://users.erols.com/merosen/kinetics.htm>
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- Thorpe A., Experimental error and error analysis: just how good are those results, *Chemistry Review*, November 2001

## Teachers' Notes

### General

This investigation is based around an experiment that can be found in some practical chemistry books. The practical techniques are fairly straightforward and students of all abilities should be able to carry out the experiments successfully. Students will need to learn how to calibrate and use a colorimeter.

The method suggested on the student experiment sheet may not be suitable for varying the concentration of potassium manganate(VII) because the colour is very intense and the colorimeter may not be able to distinguish between the different concentrations.

### Chemical Principles

Reaction Kinetics

### Essential Equipment

Burettes, pipettes, colorimeter

### Essential Chemicals

Potassium manganate(VII), ethanedioic acid, sulphuric acid,

### Safety

No risk assessment has been given. It is essential that students prepare a detailed risk assessment before they start. Teachers must be satisfied that this is suitable for the proposed investigation.

## Starter Experiment - Investigating the rate of reaction between manganate(VII) ions and oxalate ions

Here is a suggested method to investigate the effect of varying the concentration of oxalate ions.

Prepare the following solutions

- Potassium manganate(VII)  $0.001 \text{ mol dm}^{-3}$
- Oxalic (ethanedioic) acid  $0.1 \text{ mol dm}^{-3}$
- Sulphuric acid  $1 \text{ mol dm}^{-3}$

You will need to think about how much of each solution to prepare. This will depend on how much of each solution is used in each experiment and how many experiments you do (including any repeats).

You need to prepare a series of solutions to calibrate the colorimeter before you start the main experiment.

Use pipettes and /or burettes to prepare the following mixtures. As soon as you have added the oxalic acid you must immediately transfer a portion of the solution to the colorimeter and begin to follow the reaction.

Expt	Potassium manganate(VII) ( $\text{cm}^3$ )	Sulphuric acid ( $\text{cm}^3$ )	Water ( $\text{cm}^3$ )	Oxalic acid ( $\text{cm}^3$ )
1	10	10	8	2
2	10	10	6	4
3	10	10	4	6
4	10	10	2	8
5	10	10	0	10

You need to record the readings at regular time intervals until the reaction has finished or until you have enough readings to draw a suitable graph.