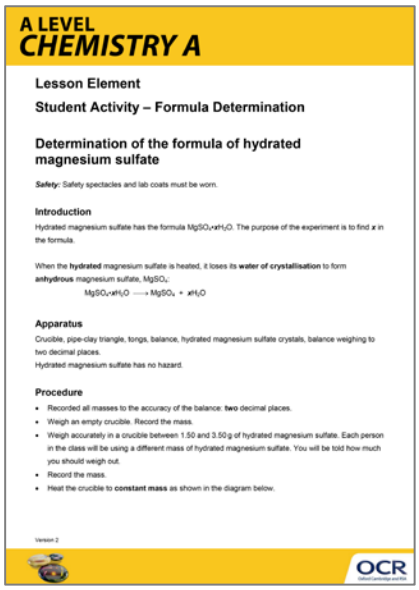
Lesson Element

Formula Determination - Teacher Guidance

Instructions and answers for teachers

These instructions should accompany the OCR resource 'Determination of the formula of hydrated magnesium sulfate' *which supports OCR A Level Chemistry A.*


A LEVEL
CHEMISTRY A

Lesson Element

Student Activity – Formula Determination

Determination of the formula of hydrated magnesium sulfate

Safety: Safety spectacles and lab coats must be worn.

Introduction

Hydrated magnesium sulfate has the formula $MgSO_4 \cdot xH_2O$. The purpose of the experiment is to find x in the formula.

When the **hydrated** magnesium sulfate is heated, it loses its **water of crystallisation** to form **anhydrous** magnesium sulfate, $MgSO_4$:

$$MgSO_4 \cdot xH_2O \longrightarrow MgSO_4 + xH_2O$$

Apparatus

Crucible, pipe-clay triangle, tongs, balance, hydrated magnesium sulfate crystals, balance weighing to two decimal places.
Hydrated magnesium sulfate has no hazard.

Procedure

- Recorded all masses to the accuracy of the balance: **two** decimal places.
- Weigh an empty crucible. Record the mass.
- Weigh accurately in a crucible between 1.50 and 3.50 g of hydrated magnesium sulfate. Each person in the class will be using a different mass of hydrated magnesium sulfate. You will be told how much you should weigh out.
- Record the mass.
- Heat the crucible to **constant mass** as shown in the diagram below.

Version 2

OCR

The Activity:

This activity is an experimental determination of the formula of a hydrated salt.

Students will first need to be introduced to the terms hydrated, anhydrous and water of crystallisation. The activity is student-centred, set up as a whole group activity but with students working in their own small groups. The emphasis throughout is getting students actively working together and thinking.

Apart from some initial organisation of the groups, the problem-solving nature of the activity allows almost all the active work to be carried out by the students who then 'learn by doing'..

This activity offers an opportunity for English skills development.

This activity offers an opportunity for maths skills development.

Associated materials:

Excel based activity sheet DG_LE_A_Level_Chemistry_Student_v1.

Introduction

Relevant learning outcome

Candidates should be able to demonstrate and apply their knowledge and understanding of:

2.1.3 Determination of formulae

(d) the terms *anhydrous*, *hydrated* and *water of crystallisation* and calculation of the formula of a hydrated salt from given percentage composition, mass composition or based on experimental results;

This activity is an experimental determination of the formula of a hydrated salt.

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Apart from some initial organisation of the groups, the problem-solving nature of the activity allows almost all the active work to be carried out by the students who then 'learn by doing'.

Task Instructions

There are various strategies for running this activity and the list below is based on a plan that has worked many times. The list should be read in association with the student activity sheet: 'Formula of magnesium sulfate'. Plan a strategy for yourself based on your local situation.

1. Copy the list of masses from the activity sheet onto the board together with spaces for the student's readings. Tell the students that they need to organise themselves into groups (or singly) depending on group size. Each group should then 'sign up' for one of the masses. The masses on the activity sheet are approximate, to one decimal place. Students will need to record their actual masses to two decimal places. The masses are needed for the graph so all students are relying on one another for the success of the activity.
2. After completing the experiment, students add their results to the results table on the board so that all groups can obtain a class set of results.
3. The students plot their graph from the pooled results. Whilst doing this, the teacher adds results to a spreadsheet version of the results, Determination of the formula of hydrated magnesium sulfate*. Alternatively, students could do this themselves. The results are projected onto a screen

and the graph is produced in real time with a best-fit straight line which can be positioned by the teacher or automatically generated.

It is important that the teacher has reviewed the spreadsheet to see what can be done and to work out the best approach. Further details are outlined at the end of this activity.

4. When all results are in and the electronic graph on the spreadsheet (Determination of the formula of hydrated magnesium sulfate*) is drawn, the results can be reviewed (teacher-led). It may be that some results are clearly anomalous and can be voted 'out'. The effect on the line of removing anomalous results is an interesting discussion point.

5. Students work through the remaining questions on the activity sheet. The best students should be able to work out the value of ***x*** independently but this can all be drawn together using the electronic projected graph.

Alternative use of this activity

This activity has been used successfully, not within traditional 'working through the specification' but, as a starter activity for A level Chemistry. From GCSE science, students will have covered much of the required concepts.

The experiment is straightforward to carry out, gives excellent results and allows many skills to be demonstrated.

The activity acts an excellent ice-breaker and allows students to carry out an experiment and indirectly use the mole without realising it. If used as a 'course-starter', students will be able to find out where common apparatus is located in the laboratory and it also gives the chance of identifying able students (who may fly through the task) and weaker students who may need additional help.

*This is available at http://www.ocr.org.uk/qualifications/as-a-level-gce-chemistry-a-h032-h432-from-2015

Teacher Preparation

As the activity is carried out almost exclusively by the students, organisation is the key to success.

Ensure that you have read the activity sheet thoroughly and can see what needs to be done behind the scenes for this to work successfully.

The activity is very enjoyable and it is refreshing to see what students are able to do if allowed to make decisions themselves.

A full risk assessment should be undertaken before carrying out the activity.

Each group will need:

- Copies of the Student Sheets for this activity
- **Apparatus:** Crucible, pipe-clay triangle, tongs, Bunsen burner, tripod stand, heat-proof mat
  Access to balance weighing to two decimal places.
- **Chemicals:**
  Hydrated magnesium sulfate crystals No Hazard
- **Graph paper**
- **Calculators**

Each student will need a copy of the Periodic Table

Teacher will need:

- **Computer** with projector to screen.

  Spreadsheet file: Determining the formula of hydrated magnesium sulfate.xls

  This file contains several worksheets:

  - A blank with two different coloured lines that can be positioned to get ‘best fit lines,
  - Several worksheets showing actual results from this activity.
    There are two versions, one with lines that can be positioned by the teacher, the others with an automatically-drawn best-fit line.
  - Adaptation for ‘formula determination of magnesium oxide’.
    This gives ideas for extending this approach to other experiments although care should be taken not to overplay the technique or the novelty factor disappears.