

NZQA Approved

Internal Assessment Resource

Chemistry Level 3

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| This resource supports assessment against:  Achievement Standard 91387  Carry out an investigation in chemistry involving quantitative analysis |
| Resource title: How stable is your aspirin? |
| 4 credits |
| This resource:   * Clarifies the requirements of the standard * Supports good assessment practice * Should be subjected to the school’s usual assessment quality assurance process * Should be modified to make the context relevant to students in their school environment and ensure that submitted evidence is authentic |

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| Date version published by Ministry of Education | February 2017 Version 2  To support internal assessment from 2017 |
| Quality assurance status | These materials have been quality assured by NZQA.  NZQA Approved number: A-A-02-2017-91387-02-6370 |
| Authenticity of evidence | Teachers must manage authenticity for any assessment from a public source, because students may have access to the assessment schedule or student exemplar material.  Using this assessment resource without modification may mean that students’ work is not authentic. The teacher may need to change figures, measurements or data sources or set a different context or topic to be investigated or a different text to read or perform. |

**Internal Assessment Resource**

Achievement Standard Chemistry 91387: Carry out an investigation in chemistry involving quantitative analysis

Resource reference: Chemistry 3.1B v2

Resource title: How stable is your aspirin?

Credits: 4

Teacher guidelines

The following guidelines are supplied to enable teachers to carry out valid and consistent assessment using this internal assessment resource.

Teachers need to be very familiar with the outcome being assessed by Achievement Standard Chemistry 91387. The achievement criteria and the explanatory notes contain information, definitions, and requirements that are crucial when interpreting the Standard and assessing students against it.

Context/setting

This activity requires students to investigate the hydrolysis of aspirin to salicylic acid under different conditions.

Students may plan and carry out the investigation in groups, but each student must collect data for at least one independent variable. Students may also carry out the whole investigation individually.

Students keep a logbook, process the group data, and write their report individually.

If temperature is the independent variable, students need to dissolve the aspirin in water before heating it so that hydrolysis can occur.

Conditions

Please refer to the conditions of assessment for this standard.

Students must be given sufficient time to show their understanding.

Ensure that students follow standard laboratory safety procedures as outlined in *Safety and Science: A Guidance Manual for New Zealand Schools*.

Provide students with instructions on how to use the colorimeter.

Resource requirements

* colorimeter (with instructions)
* solid salicylic acid
* 95% ethanol
* .0250 mol L-1 Iron (III) nitrate solution.

Additional information

Further information on assessment and management issues, other practical investigation examples, and a question and answer archive can be found at [www.chemteach.ac.nz](http://www.chemteach.ac.nz)

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| Achievement | Achievement with Merit | Achievement with Excellence |
| Carry out an investigation in chemistry involving quantitative analysis. | Carry out an in-depth investigation in chemistry involving quantitative analysis. | Carry out a comprehensive investigation in chemistry involving quantitative analysis. |

Student instructions

Introduction

This activity requires you to investigate the stability of aspirin (acetyl salicylic acid) in different conditions (such as different pH, temperature, and moisture levels). You can plan and carry out the investigation as a group, but you need to keep your own logbook throughout the investigation. You must process the data on your own and write an individual report for submission.

You will be assessed on the comprehensiveness of your investigation, which involves:

* keeping a logbook that contains details of the development of the purpose, procedure, raw data, and calculations
* developing and carrying out a procedure to collect data
* processing the data to reach a conclusion
* discussing the investigation in terms of the procedure used and the reliability of the data
* reporting your investigation in a written report.

You have two to three weeks to complete this task.

Task

Aspirin (acetyl salicylic acid) breaks down (by hydrolysis) to form salicylic acid. The amount of salicylic acid can be determined by colorimetric analysis. You are to conduct an investigation into the stability of acid under different circumstances.

A method used to measure the amount of salicylic acid in solution is given in Resource A.

In a group define the purpose of your investigation, conduct background research, and identify how you will ensure safety (for example, safety considerations and how you will reduce any possible risks). The purpose should include exploring possible trend or pattern in the quantity of acetyl salicylic.

Plan your practical work and conduct some trials to refine your method. Each member of the group should collect and record data for at least one of the independent variables. Record this information in a logbook. All data should then be collected together and shared with everyone in the group.

Working individually, process the data and write a report. Your report should be a maximum of 1,000 words and include the following sections:

* purpose
* description of procedure – this must include a description of how significant variables are controlled, preparation of samples, and any modifications made to the method during the course of the investigation
* results
* conclusion
* discussion – an evaluation of the whole investigation that considers:
* an evaluation of the reliability of data by considering the procedure used and sources of error
* reasons for any modifications made to the original method
* the accuracy and reliability of the data collected
* comments on the significance and validity of the conclusion
* links between the conclusion(s) and chemical principles and/or real life applications
* a bibliography that acknowledges and identifies sources of information.

Hand in your report along with your logbook containing the raw data you collected and a summary of all the data collected by the group.

Resource A

**Determination of the amount of aspirin**

Taken from *“The Synthesis and Analysis of Aspirin”*

[http://www.p-forster.com/Attachments/Aspirin/Aspirin Synt & Beer-Lambert.pdf](http://www.p-forster.com/Attachments/Aspirin/Aspirin%20Synt%20&%20Beer-Lambert.pdf)

To access this PDF, paste the text into your search engine and select Quick View.

**Test the colorimetric absorbance of an aspirin sample**

Salicylic acid reacts with acidified iron (III) nitrate to produce a violet complex, tetraaquosalicylatroiron (III).

You will prepare a set of standard solutions of the violet complex, tetraaquosalicylatroiron (III). The absorbance of the standard solutions can be determined using a colorimeter. A standard curve can then be created and used to determine the amount of salicylic acid in the aspirin tablets.

**Prepare a set of salicylic acid standard solutions and a standard curve**

1. Measure out about 0.200 g of salicylic acid. Record the precise mass that you use.
2. Transfer the salicylic acid to a 250 mL beaker and add 10 mL of 95% ethanol. Swirl the beaker to dissolve the solid.
3. Add 150 mL of distilled water to the beaker. Mix the solution.
4. Transfer the solution from the beaker to a 250 mL volumetric flask and make up to the mark with distilled water, making sure that you have transferred all the salicylic acid to the flask. Mix the solution.
5. Calculate the precise concentration of your stock solution and record it in your logbook.
6. To prepare 100 mL of the violet complex solution, quantitatively transfer 10 mL of the stock salicylic acid solution you prepared above to a 100 mL volumetric flask.
7. Add 0.0250 mol L-1 Fe (NO3)3 solution to the flask to make precisely 100 mL.
8. Use this solution to prepare a set of standard solutions according to the table below. Mix these thoroughly.

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| **Standard solution number** | **Volume of complex solution (mL)** | **Water (mL)** |
| 1 | 10.0 | 0.0 |
| 2 | 7.5 | 2.5 |
| 3 | 5.0 | 5.0 |
| 4 | 2.5 | 7.5 |

1. Calculate the precise concentrations of the four standard solutions in the table above and record them in your logbook.
2. Set up the colorimeter according to the manufacturer’s instructions.
3. Record the absorbances of your set of standard solutions.
4. Prepare a standard curve showing absorbance vs. concentration of salicylic acid in the standard solutions.

**Determine the concentration of salicylic acid in samples**

1. Measure out about 0.200 g of each of your treated aspirin samples (for example, exposed to different temperatures, pH levels, moisture levels) and transfer them to 250 mL beakers. Record the precise mass of aspirin that you use for each sample.
2. Add 10 mL of 95% ethanol to each beaker of aspirin sample. Swirl the mixture to dissolve the solid.
3. Add 150 mL of distilled water to each beaker. Mix the solutions.
4. Quantitatively transfer the solutions from the beakers to 250 mL volumetric flasks. Make up to the mark using distilled water. Mix thoroughly.
5. Transfer 5 mL of each of the aspirin solutions from the 250 mL volumetric flasks to clean, dry 100 mL volumetric flasks. Add 0.025 M Fe (NO3)3 solution to each flask to make precisely 100 mL. Mix the solutions thoroughly.
6. Measure and record the absorbance of the treated aspirin samples. This must be done within five minutes.
7. Repeat Steps 5 and 6 twice with new aliquots of the treated aspirin samples.
8. Use your standard curve to determine the concentration of salicylic acid in the samples.

Assessment schedule: Chemistry 91387 How stable is your aspirin?

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| Evidence/Judgements for Achievement | Evidence/Judgements for Achievement with Merit | Evidence/Judgements for Achievement with Excellence |
| The student carries out an investigation in chemistry involving quantitative analysis.  They do this by investigating the stability of acid under certain conditions leading to a conclusion based on the processed data.  They have kept a logbook and produced a report.  In their investigation the student has:   * developed a purpose * explored a possible trend or pattern in the quantity of substance in a sample * developed and carried out a procedure to collect data * described the procedure, including preparation of samples and the analytical technique used * chosen a range of values for the independent variable * collected and recorded sufficient data to enable a conclusion to be reached * provided a summary of the collected and processed data * made a conclusion based on processed data. | The student carries out an in-depth investigation in chemistry involving quantitative analysis.  They do this by investigating the stability of acid under certain conditions leading to a conclusion that links the processed data to the purpose of the investigation.  They have kept a logbook and produced a report.  In their investigation the student has:   * carried out trials * controlled significant variables * chosen a valid range of values for the independent variable * described their method in sufficient detail to enable it to be duplicated * standardised standard solution(s) * shown the mathematical steps used to process the data * accurately processed the data to reach a valid conclusion * made a valid conclusion relevant to the purpose of the investigation * explained how the procedure used contributed to the collection of quality data.   *.* | The student carries out a comprehensive investigation in chemistry involving quantitative analysis.  They do this by investigating the stability of acid under certain conditions leading to a comprehensive conclusion  They have kept a logbook and produced a report.  In their investigation the student has:   * accurately processed the data and used appropriate significant figures * justified the steps used in the procedure in relation to the reaction(s) and to the nature of the samples being analysed * justified how the processed data supports the conclusion(s) * evaluated the reliability of the data by considering the procedure used and sources of error * linked the conclusion(s) to chemical principles and/or real life applications.   *.* |

Final grades will be decided using professional judgement based on a holistic examination of the evidence provided against the criteria in the Achievement Standard.