Investigations Folio: Volumetric Analysis Determination of Ibuprofen content

Background Information

Ibuprofen is a pharmaceutical of the nonsteroidal anti-inflammatory (NSAID) class, that is used primarily as a medication in the treatment of pain, inflammation, and fever.



Ibuprofen contains a carboxylic acid functional group that, as a weak acid, is able to neutralise bases such as metal hydroxides.

The solubility of Ibuprofen in water, in this investigation, will be increased through the addition of glycerol (propane-1,2,3-triol) and by heating the solution to a moderate temperature. In Australia Ibuprofen is also administered as Ibuprofen lysine (the lysine salt of Ibuprofen) which offers greater solubility in the aqueous environment encountered in the human body.

Manufacturers of pharmaceuticals are required to disclose the quantity of Ibuprofen contained in each tablet. This investigation requires confirmation of the commercial manufacturers claims. In Australia dosage, should conform to 200 mg of Ibuprofen per tablet. Construct a concise introduction to the investigation, which explains the chemical and physical properties of Ibuprofen, which are relevant to the investigation.

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Assessment Conditions

- You will have the 110-minute Tutorial to complete all titrations for the commercial brand of Ibuprofen allocated and collaborate with others to collate results. This will be completed under direct supervision.
- During this period you will be assessed according to selected skills in the preparation of samples and solutions by dilution, and in performing titration through the manipulation of apparatus and implementation of safe procedures.
- You will be required to use the spaces provided to record annotated evidence of your understanding – to be submitted during the investigation under direct supervision.
- You will then be required to elaborate upon this evidence in the construction of a final formal report. **No new evidence may be introduced.** You will have one further week to complete.
- You will work collaboratively, in pairs, during the investigation, but each student must demonstrate evidence of original thought through the submission of an individual report.

Apparatus & Reagents

Wash bottle	Beakers	Glass stirring rod
Volumetric flask	Measuring Cylinders	Glycerol
Volumetric pipette	Funnel	Tablets (Ibuprofen of differing brands)
Burette	White tile	Phenolphthalein indicator
Conical flasks	Distilled water	0.100 molL ⁻¹ and 1.00 molL ⁻¹ NaOH

Safety Notes

Sodium hydroxide may cause irritation to the skin and eyes.

Wear a *lab coat* and *safety glasses* during this practical. Refer to MSDS supplied for each reagent.

Prelab

Three pieces of glassware that can be used to measure a volume of 20.00 mL are shown in the diagram below:



- State which one of X, Y, and Z is the most appropriate piece of glassware in which to transfer a volume of sodium hydroxide for dilution.
- Name this piece of glassware.

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Prelab

The recommended dosage of ibuprofen is 40 mg/kg/day up to a maximum of 1200 mg/day for an average sized adult.

 Calculate the concentration, in ppm, for an average adult of 70 kg mass who had reached the maximum recommended daily intake.

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- Determine how many tablets containing 200 mg of Ibuprofen would be consumed to reach the recommended level.
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Pre-investigation Rationale

You have been provided with 1.00 molL⁻¹ sodium hydroxide, NaOH, and you will be required to dilute this solution to prepare a 0.100 molL⁻¹ solution using a volumetric flask. Using the beakers, measuring cylinders, and indicator provided, determine the approximate volumes of both the 0.100 molL⁻¹ and 1.00 molL⁻¹ sodium hydroxide solution required to neutralise the ibuprofen present in one tablet. Hence, explain which concentration of sodium hydroxide is most appropriate for the titration.

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General Procedure

Neutralising the glycerol

- Rinse and prepare the burette.
- Fill the burette with sodium hydroxide solution.
- Introduce 50 mL of glycerol and 50 mL of warm water (approximately 60°C) to a conical flask.
- Add 2-3 drops of phenolphthalein indicator to the conical flask.
- Introduce the sodium hydroxide dropwise with stirring until the first permanent pink colour appears.

Performing the titration

- Refill the burette with sodium hydroxide solution.
- Place one tablet into the pink neutralised solution in the conical flask.
- Crush and incorporate the tablet with a glass stirring rod.
- Add an additional 2-3 drops of phenolphthalein indicator to the conical flask.
- Titrate the contents of the flask with the sodium hydroxide from the burette until the first permanent faint pink colour appears. Record the titre and repeat for three further titrations.
- Calculate the mass of ibuprofen present in each tablet.
- Collate results from the other groups present for further analysis.

Purpose

Carefully read the background information and general procedure provided. State the *purpose* of the investigation.



Results

• Construct and complete appropriate table/s for the collection of data and observations.

 Outline critical procedures in the preparation and use of a volumetric pipette and in the preparation and use of a burette. Describe the potential effect on the final concentration if these procedures are *not* followed.

 Identify sources of *random* and *systematic* error encountered during the procedures, explain their significance, and outline any evidence of their presence in the results obtained.

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 Construct appropriate equations to represent the acid/base reactions considered during the titrations.

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 Using your results and those collated determine the mass, in mg, of Ibuprofen in each of the tablets.

Teacher's Signature:		Limited evidence	Some evidence	Good evidence	Strong evidence	Exemplary evidence
Skill	Comment	E	D	С	В	А
Selection and use of						
appropriate glassware						
Reading of volumes						
Determination of endpoint						
Safety and organisation of						
the workspace						
Time management						

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Collaboration (Optional)

 Describe how working collaboratively with your partner during the practical led to greater effectiveness and efficiency. Outline your contribution. Discuss how the collation of results from other groups investigating the tablets, increased your understanding of the procedure and confidence in the results.



Conclusion

• Construct suitable conclusions based on your findings.



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SACE Number	/Name:	Intended Student Learning	Knowledge & Application	Investigation, Analysis & Evaluation		
Purpose [Investigation]	State the purpose of the investigation or experiment.					
Design [knowledge	Interpret diagrams of the apparatus used in an experiment.					
& understanding]	Design procedures to investigate.					
Procedures	Follow instructions accurately and safely.					
[Investigation]	Select appropriate apparatus for the measurement of volume.					
	Prepare solutions and undertake titrations.					
Safety & Ethics	Negotiate procedures with the other members of a team and per	form				
[Investigation]	the role of a team member.					
[Application]						
Errors in	Identify sources of errors that may occur in a practical investigation and					
measurements	describe their effect on the results.					
[Analysis &						
Evaluation]						
Precision,	Select an instrument of appropriate resolution for a measuremen					
Reliability &	Record and use measurements to an appropriate number of signi					
Accuracy [Analysis	figures.					
& Evaluation]						
Information & Data	Distinguish between qualitative and quantitative evidence.					
[Investigation]	Present data in an appropriate tabular form, showing the quantities					
	measured and the units used, and the values observed.					
Interpretation &	Analyse and evaluate procedures from an investigation, and indic	ate the				
Evaluation	effect on the results.					
[Analysis &	Perform calculations from the collected data.					
Evaluation	Write a conclusion that is based on the results of an investigation.					
Communication	Use chemistry terminology, conventions, and symbols that are					
	appropriate for the purpose of a practical report.					
	Write appropriate chemical equations.					
	Evidence of Learning – Dist					
	Grade by Sub	odivision				

	A	В	С	D	E
Investigation,	Designs a logical, coherent, and detailed chemistry investigation.	Designs a well-considered and clear chemistry investigation.	Designs a considered and generally clear chemistry investigation.	Prepares the outline of a chemistry investigation.	Identifies a simple procedure for a chemistry investigation.
Analysis, and Evaluation	Setailed chemistry investigation.chemistry investigation.clear chemistry investigation.Obtains records, and represents data, using appropriate conventions and formats accurately and highly effectively.Obtains, records, and represents data, 		Obtains, records, and represents data, using conventions and formats inconsistently, with occasional accuracy and effectiveness. Describes data and undertakes some basic interpretation to formulate a basic conclusion. Attempts to evaluate procedures or suggest an effect on data.	Attempts to record and represent some data with limited accuracy or effectiveness. Attempts to describe results and/or interpret data to formulate a basic conclusion. Acknowledges that procedures affect data.	
Knowledge and Application	Demonstrates deep and broad knowledge and understanding of a range of chemical concepts. Develops and applies chemical concepts highly effectively in new and familiar contexts. Critically explores and understands in depth the interaction between science and society. Communicates knowledge and understanding of chemistry coherently, with highly effective use of appropriate terms, conventions, and representations.	Demonstrates some depth and breadth of knowledge and understanding of a range of chemical concepts. Develops and applies chemical concepts mostly effectively in new and familiar contexts. Logically explores and understands in some depth the interaction between science and society. Communicates knowledge and understanding of chemistry mostly coherently, with effective use of appropriate terms, conventions, and representations.	Demonstrates knowledge and understanding of a general range of chemical concepts. Develops and applies chemical concepts generally effectively in new or familiar contexts. Explores and understands aspects of the interaction between science and society. Communicates knowledge and understanding of chemistry generally effectively, using some appropriate terms, conventions, and representations.	Demonstrates some basic knowledge and partial understanding of chemical concepts. Develops and applies some chemical concepts in familiar contexts. Partially explores and recognises aspects of the interaction between science and society. Communicates basic chemical information, using some appropriate terms, conventions, and/or representations.	Demonstrates limited recognition and awareness of chemical concepts. Attempts to develop and apply chemical concepts in familiar contexts. Attempts to explore and identify an aspect of the interaction between science and society. Attempts to communicate information about chemistry.