

V Scally Calorimetry Assignment

by Vick Scally

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UWTSD
OME DEGREE COURSE

Victoria C. Scally

Calorimetry Lab assignment

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Table of Contents

Introduction	3
Results	3, 4, 5
Discussion	5
1. Relevance to OME	5
2. Conclusion	5
3. References.....	6
4. Appendix.....	6
5.1 Materials.....	6
5.2 Method	6,7

Tables

1. Table 1: Reaction 1	3
2. Table 2: Reaction 2	4
3. Table 3: Reaction 3	5

1. INTRODUCTION

Calorimetry

Calorimetry is the technique used to measure the amount of heat transferred to or from an object during a reaction. In this instance the experiment is used to find the heat capacity of an aluminium block and also to determine the heat ^{transferred} lost during a chemical reaction. The heat capacity of the calorimeter can be ^{calculated} measured by ^{measuring} calculating the change in ^{temperature} energy of water. Heat capacity can be calculated by an unknown sample using the energy change of water and energy change can be calculated by finding the energy change of a reaction in water.

The hypothesis of calorimetry is based on energy conservation.

what exactly is the hypothesis?

Results

Heat Capacity of water

Independent variable – Temperature of hot water added to calorimeter

Dependent variable – Temperature reached within calorimeter

Control – Temperature of cold water & volume of cold water

Heat Capacity of Metal

Independent variable – Temperature & Mass of metal used

Dependent variable – Temperature reached within calorimeter

Control – Heat capacity of calorimeter

Heat of reaction

Independent variable – Volume of reactant

Dependent variable – Temperature reached within calorimeter

Control- Heat capacity of calorimeter *variables are correctly identified*

Reaction 1

Table 1 title

Temperature	°C	Volume	mL	Change in Temperature	°C
T _{cold}	24.0	V _{cold}	50	ΔT	22.2
T _{hot}	95.0	V _{hot}	50	ΔT	-48.8
T _{max}	46.2	V _{combo}	100	ΔT calorimeter	22.2

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Using the above table heat change can be calculated.

$$Q = m \times c \times \Delta T$$

(heat lost from water)

$$Q = 50.0 \times 4.186 \times -48.8$$

$$= -10213.04 \text{ J (energy lost from the water)}$$

(heat gain of water)

$$Q = 50 \times 4.186 \times 22.2$$

$$= 4646.46 \text{ J}$$

$$10213.94 = 4646.46 + Q_{\text{Calorimeter}}$$

$$10213.94 = 4646.46 + 5567.38$$

$$Q = HC \times \Delta T$$

$$5567.38 / 22.2 = 250.78 \text{ J/C}^\circ \text{ calculations are correct}$$

Reaction 2

Table 2 title

Q _{cold-water}	Q _{hot-water}	Q _{calorimeter}
-10213.94 J	4646.46 J	5567.38 J

Temperature Metal	Temperature Water	Temperature Equilibrium
95.0	23.6	31.6

Mass metal (g)	Volume Water- mL
18.6	30.0

$$Q_{\text{Water}} = 30.0 \times 4.186 \times 8 = 1004.6 \text{ J}$$

$$c = \frac{Q}{m \times \Delta T}$$

$$c = 1004.6 / 18.6 \times 63.4$$

$$= 0.852 \text{ J/g C}^\circ$$

Reaction 3

Table 3

Volume	mL	Concentration	Mol/L	Moles of Reactant	Moles
V _{HCL}	50.0	C _{HCL}	1.0 mol/L	n _{HCL}	0.05
V _{NaOH}	52.0	C _{NaOH}	1.0 mol/L	n _{NaOH}	0.052

Temperature Start	Temperature End
28.5	33.1

$$-Q_{\text{Reaction}} = m_{\text{water}} \times c_{\text{water}} \times \Delta T_{\text{water}} + H_{\text{Calorimeter}} \times \Delta T_{\text{calorimeter}}$$

$$= 102.0 \times 4.186 \times 4.6 + 250.78 \times 4.6$$
$$= -3117.66 \text{ J}$$

$$-3117.66 / 0.05 = -62353 \text{ J/mol} \text{ calculations are correct}$$

Discussion

As shown calorimetry is a very clever technique to gather information on energy exchange of materials. As shown in the second experiment it is possible to calculate the heat capacity of an object i.e metal. The last experiment showed that energy of specific reactions can be calculated, this is particularly pertinent in the OME industry due to the nature of explosives and the release of their energy in their reactions. This could be applied in endo/exothermic reactions.

It is important to note however, that there are high chances for error in these tests. Heat can be lost when transferring the metal to the calorimeter, which decreases the accuracy of results, it is important to note that the quality of the thermometers can affect results and create incorrect readings.

The quality of the calorimeter used is also important to note, heat can be lost through the walls of the calorimeter and also affect the readings and therefore the results of the experiments.

Using the highest quality equipment in your experiments and ensuring quick and effective transfer of materials into the calorimeter will also ensure that the readings taken are as precise as possible.

Relevance to OME

Calorimetry can be used in explosive safety.

Calorimetry is used for the preliminary testing of compatibility of widely used military plastic bonded explosives.

This ensures that usually "safe" explosives are not made dangerous by coming into contact with substances that are considered 'inert'. This ensures the safe storage of explosives and prevents catastrophic accidents from occurring .^[1]

Conclusion

Calorimetry can be used in a number of different experiments. It can effectively help you to calculate the energy released in an experiment and the heat capacity of objects. However as discussed above there are margins for error depending on the quality of your equipment.

These experiments are also an effective way of ensuring the safety of explosive materials due to the calculation of energy release when combined with other materials.

References

1. US Military, Minutes of the Explosive Safety Seminar (22nd) Held in Anaheim, California August 26-28th. March 1985. Accessed online 31/04/2025. (apps.dtic.mil/sti/tr/pdf/ADP005388.pdf).

Appendix

- Materials : Two stacked Styrofoam cups, 1 x lid, 1 x thermometer, 1 x stirring rod, 1 x bunsen burner, 1 x lump of metal, 1 x clamp, 1 x water bath, 1 x measuring cylinder, HCl, NaOH, 1 x beaker

- Method

Experiment 1 – Set up the calorimeter. Add 50 mL of water to the Styrofoam cup and close the lid add the thermometer and the stirring rod.

Take 50mL of water in a beaker and heat to 80 degrees C. Turn of the Bunsen and wait for the temperature to drop to 60 and record this temperature as T Hot.

Add the hot water to the calorimeter and mix thoroughly. While doing this watch the thermometer and record the maximum temperature reached – equilibrium temperature. This is T max.

Calculate the heat capacity using the equations.

Experiment 2 – Use the same apparatus as above.

Heat the metal sample in a water bath after is has been weighed and the mass recorded. Boil it in the water bath for 5 minutes to allow the metal to reach the same temperature as the water.

Close of the heat and wait for 2 minutes for the heat of the metal and water to equilibrate.

Measure 30mL of water and add this to the calorimeter, record the starting temperature.

Add the metal piece to the calorimeter using tongs.

Stir the water and record the temperature every 10 seconds.

Continue to record till the water reaches a max temperature and then cooled down by 2 degrees C. Record the maximum temperature.

Calculate the specific heat of the metal.

Experiment 3 – Add 52mL of NaOH into the clean calorimeter and pour 50mL of 1mol HCl into a beaker.

Wait for these to reach the same temperature before starting the experiment.

Add the HCl to the calorimeter and quickly add the lid. Calculate the temperature when it has reached a maximum which will be the T end.

Calculate the Q reaction which is the heat reaction and the heat capacity of the calorimeter calculated in the first experiment.

Calculate the molar heat of the reaction.

V Sally Calorimetry Assignment

GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

54/100

Engagement with Literature Skills 6/15

The report cites only one reference, a military document from 1985, which is outdated and lacks scientific depth. There is no use of peer-reviewed literature, no textbook references for calorimetry principles, and no supporting sources for theoretical values (e.g., specific heat of aluminium, standard enthalpy of neutralisation). The reference includes an access date, but formatting is inconsistent with IEEE standards.

Feedback: Include multiple up-to-date scientific sources and apply IEEE referencing correctly. Use literature to support theory and compare your findings to accepted values.

Knowledge and Understanding Skills 11/20

The aim and hypothesis (based on energy conservation) are stated, and a brief introduction to calorimetry is provided. However, the hypothesis is vague, and there is no formal identification or classification of variables. Definitions are brief and sometimes technically unclear (e.g., the term "heat capacity of water" instead of "heat gained by water"). Units are generally correct but the equations are not shown.

Feedback: Clearly define your hypothesis and variables. Compare your results with accepted literature values to demonstrate deeper understanding.

Cognitive and Intellectual Skills 13/25

The report shows some logical analysis. There is a basic recognition of sources of error (e.g., thermometer quality, heat loss), and the application of calorimetry to OME is briefly discussed. However, the analysis is descriptive and lacks critical depth. The report does not reflect on how inaccuracies impacted specific results, nor does it explore why the calculated molar enthalpy (-62.35 kJ/mol) deviates from standard

values. There's no literature comparison, no breakdown of uncertainty, and no consideration of the validity of measured values.

Feedback: Go beyond description—evaluate the reliability of your results and support your interpretation with theory and data.

Practical Application Skills 14/25

The procedures are mostly correct, and calculations for calorimeter heat capacity and molar heat of reaction are technically sound. The specific heat of aluminium is reasonably close to expected value but it is not correctly calculated. Units and sig. figs are mostly used correctly,

Feedback: Use correct significant figures and show calculation steps clearly. Include raw data tables where appropriate and explain how results were derived.

Transferable/Professional Skills 10/15

The report is well-structured with clear sections and mostly appropriate language, though some phrasing is informal. Figures and calculations are not fully integrated into the discussion, and referencing is minimal and incorrectly formatted.

Feedback: Keep the clear structure, but improve academic tone, referencing, and integration of results into your discussion.

PAGE 1

PAGE 2

PAGE 3

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Text Comment. what exactly is the hypothesis?

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PAGE 4

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Text Comment. if the calculations were performed correctly, the specific heat of Al would be 2.55 J/g-degC

PAGE 5

Text Comment. calculations are correct

Text Comment. there is no comparison to literature values

PAGE 6

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PAGE 7

Text Comment. scan of raw data not included for verification