**Year 11 Chemistry investigation**

**Enthalpy Changes**

**Background knowledge**

[](http://www.google.com.au/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&cad=rja&uact=8&ved=0ahUKEwj4ufKi24DLAhUFkZQKHe_hBK4QjRwIBw&url=http://www.packworld.com/package-component/label/nestl%C3%A9-tests-award-winning-can&psig=AFQjCNFyNyMy_KbG_HEW_852XudZZ4m_dA&ust=1455864269264385)

In 2001Nescafe launched a self-heating can of coffee. To heat up the coffee a button is pressed which mixes the heating ingredients; a single step mixes calcium oxide and water to produce calcium hydroxide and generate heat.

CaO + H2O Ca(OH)2 ΔH –82 kJmol–1

The can warms up 210 ml of coffee by 40 °C.

1. Classify this reaction as either endothermic or exothermic.

1. Assuming that the heat capacity for coffee is the same as that of water (4.18 JK-1g–1) calculate the energy needed to warm 210 ml of coffee by 40 °C using the following formula: **q=mCΔt**
2. Use this value to calculate the minimum mass of CaO needed in the can for it to function as specified.
3. Draw a fully labelled enthalpy diagram for the reaction of calcium oxide with water.

**Investigation**

The science department at Applecross received the following letter from the ***Apple-icious* Drinks Company** of Applecross. Your job is to plan and conduct the investigation and present a report to their Development Manager: M.Y. Chemteacher. The report should be presented in the manner of a formal lab report.

Dear Scientist,

Congratulations! You and your group have been selected for the contract job of designing my company’s latest product. We are working to a tight schedule so your product design must be finished A.S.A.P.

The product is a drink can that, when desired, can be activated to cool the drink it contains wherever the user may be at the time. We are looking for a product that can cool 100 ml of drinkable water by 5 °C in no more than 5 minutes. Try not to exceed this temperature change as we do not want our customers’ teeth to freeze!

You and your team will need to use your knowledge of chemistry to come up with a product design which includes full details of the cooling process with exact quantities of any chemicals used and time periods required to give us our desired –5 °C temperature change.

We would like you to provide us with **both** theoretical and experimental quantities for any chemicals used in order for us to evaluate the effectiveness of your design.

In order to pass the strict requirements of the Food Standards Agency it is also imperative that the cooling process is safe. We at the department have done a little research ourselves and have found two chemicals that we think would be useful;

Ammonium chloride (NH4Cl); solubility 37.2 g / 100 g water, $5.10 per 500 g

Ammonium nitrate (NH4NO3); solubility 192 g / 100 g water, $21.80 per 500 g

Please include with your final product design an explanation of which chemical you decided most suitable and why, including careful consideration of the Health and Safety implications of your chosen design.

Finally we need to know that you have successfully tested your design. Please provide data to indicate this.

Thank you for accepting this contract and we look forward to seeing your results.

Regards,

M. Y. Chemteacher

*Product Development Manager*

**Marking Rubric**

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| --- | --- | --- | --- |
| **Section** | **Expectation** | **Max Mark** | **Actual Mark** |
| **Introduction** | 2-3 sentences explaining the scientific theory, any assumptions that have been made, the theoretical calculations of mass of solute using: **q=mCΔT** | **3** |  |
| **Aim** | 1-2 sentences explaining the purpose of the experiment. | **2** |  |
| **Equipment** | A comprehensive list of all the equipment required | **2** |  |
| **Method** | An appropriately sequenced and detailed description of the procedure using correct scientific terminology. | **4** |  |
| **Safety** | Details of any hazards and the appropriate precautions to avoid accident/injury | **2** |  |
| **Diagram** | An appropriately labelled diagram | **2** |  |
| **Results** | Results tables and graphs detailing the outcome of the experimental trials also including an enthalpy graph | **6** |  |
| **Conclusion** | Discussion of theoretical versus actual results and an explanation of any perceived inconsistencies | **2** |  |
| **Evaluation** | Discussion of possible inaccuracies and the limitations of the equipment | **2** |  |

**TOTAL 25 \_\_\_\_\_\_**

**Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Year 11 Chemistry investigation**

**Enthalpy Changes**

**Introduction**

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**Aim**

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**Equipment**

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**Method**

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**Diagram**

**Safety**

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**Results** (Attach graph paper if drawing a graph)

**Conclusion**

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**Evaluation**

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**Additional notes**

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