

## Exemplar Materials: Unit 8 Investigating the Scientist's Work

<b>EXEMPLAR PORTFOLIO WORK: ASSIGNMENT 8</b>  <b>Task 2a, AO3, Scientific Report</b>	<b>Commentary on Mark Allocation</b>
<p>AIM: The aim of this investigation was to determine experimentally the amount of calcium in different types of milk.</p> <p>I chose this investigation out of curiosity. There are so many brands of milk on the market .I wanted to find out how the calcium content varies from brand to brand.</p> <p>The original plan was to find out experimentally the amount of calcium in different types of milk including baby formula. I could not get a sample of baby formula without buying a whole tin. Buying a whole tin would not have been economical. I used children's yoghurt drink as the alternative.</p> <p><b>Background information</b></p> <p>The non-fat portion of milk contains about 302 mg calcium in an 8 ounce glass. With non-fat milk solids, which contain calcium there are 316mg calcium in an 8 ounce glass. ( web site given)</p> <p>The amounts that I found experimentally should be the same as the amounts listed on the nutritional information on the bottles or containers. My results should then let me comment on the nutritional value of different milks with respect to their calcium content.</p> <p>I found the amount of calcium by titration using a solution of ethylenediaminetetraacetic acid. (EDTA).</p> <p>EDTA can co-ordinate with calcium ions. ( reference given)</p> <p>The structure of the neutral EDTA molecule is shown below. .It can form stable and soluble complex ions with all cations except simple monovalent cations.</p> <p>EDTA is able to form stable and soluble complexes with divalent and trivalent cations.</p>	<p>Level of language – reflective Mark Band 1 only.</p> <p>Suggest not use I/we.</p> <p>Would be returned to upgrade language – overall report.</p> <p>AO3c Mark Band 1 2 marks</p> <p>(Could be returned to be upgraded to Mark band 2).</p> <p>Use of 'calcium', as opposed to calcium ions, means that AO3c cannot be more than Mark Band 1.</p> <p>(Also see later comments).</p>

<p>Calcium ions react with EDTA in a 1:1 ratio. The reaction is rapid and quantitative. However none of the components are coloured so something needs to be done to generate a visible end point. The indicator "Eriochrome Black or EBT for short is used. EBT is a blue dye which forms a weak red coloured complex with free calcium ions at a pH of 10. When EBT is added to a solution containing calcium ions there is a red colour due to the Ca(EBT) complex. A red colour was observed in the practical work.</p> <p>On addition of EDTA the colour changed from red to blue. This colour change was used as the end point. It was necessary to have:</p> <p><b>Buffer solution of pH 10</b>  <b>A solution of known molarity of EDTA (0.1mol dm<sup>-3</sup>)</b>  <b>Indicator EBT solution.</b>  <i>Why emboldened?</i></p> <p><b>Chemical Hazard notes</b>  The disodium salt of EDTA is harmful. Contact with skin and eyes should be avoided  The buffer solution of pH 10 is corrosive. Avoid breathing vapours. Use in fume hood.  Eriochrome Black T is an irritant and should not be allowed to come in contact with the skin.</p> <p><b>Safety considerations</b></p> <ul style="list-style-type: none"> <li>• The usual precautions when handling glassware for a titration should be observed.</li> <li>• Pipette fillers should be used</li> <li>• Safety glasses and gloves must be worn.</li> </ul> <p>These were made up in accordance with the standard methods (references given)</p> <p>A solution of known concentration of calcium ions was made as a reference solution.  This was done by weighing 1.00g powdered calcium carbonate . This was placed in a beaker and 25 cm<sup>3</sup> distilled water added. Then concentrated hydrochloric acid was added dropwise until the calcium carbonate had reacted and there was a clear solution. This was made up to 2.0 litres in the usual way.</p> <p><b>Titration</b>  These solutions were used for titrations of  EDTA against distilled water 50cm<sup>3</sup>  EDTA against the calcium carbonate solution containing calcium ions 25cm<sup>3</sup> and 50 cm<sup>3</sup> distilled water  EDTA against samples of milk ( 25cm<sup>3</sup> milk and 50cm<sup>3</sup> water).</p> <p>Titration carried out in the usual way.</p>	<p>AO3a Safety  (Work suitably summarised for report-reflective mark band 2).</p> <p>1 technique</p> <p>Another technique</p>
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<p>When the titration was first carried out there was no colour change, no end point was observed. Further information from different books and the internet (references given) gave the conclusion that the <i>buffer might be the possible cause of the problem. A buffer of 9.2 had</i> been used as it was thought that it would be sufficient instead of the 10 required. A pH 10 buffer solution was prepared.</p> <p>The titration was attempted again using a pH 10 buffer and again there was no colour change. Research from further literature indicated that the indicator used, Eriochrome blackT, would work in a substitution titration in the presence of magnesium ions. With calcium ions alone no sharp end point can be obtained.</p> <p>2 cm<sup>3</sup> of magnesium sulphate was added in each titration. The titration was attempted a third time but there were problems with the colour change,. The calcium solution changed colour before the EDTA was added. I prepared a 0.1M EDTA solution and also fresh indicator solution using methanol instead of ethanol, The next attempt was a success and the expected colour change observed (references given)</p>	<p>AO3a Mark allocated would be related to Teacher assessment sheet and nature of tasks set.</p> <p>Results looked at for accuracy. Mark band 2 3 marks</p> <p>Evidence of different techniques needed for Mark Band 3 AO3b Mark Band 2 3 marks.</p> <p>Explanation of changes – this should also be included in plan.</p> <p>Detailed information on reference material should be included.</p>
<p><b>Interpretation of data collected</b></p> <p>My results are consistent and close to published data. The soya milk has the highest amount of calcium. This is due to the fact that the calcium is added so the manufacturer can add as much as possible, whereas with dairy milk the amount of calcium is determined by the type of cow and the feed that the cows eat.</p> <p>In conclusion in this investigation I found that the calcium content is more or less the same in all brands although the dairy alternatives have more calcium, this is because they are fortified, calcium is added and so the manufacturers are at liberty to add more calcium, milk and dairy alternatives are a great source of calcium, hence a great supply on the market today many brands to choose from, the brand is the most significant difference between the milk samples, whether it be goats or cows milk the calcium content is roughly the same. It is up to the individual to choose the most convenient in size and price or buy because of taste preference. Whatever one likes there is something for every taste and pocket down the milk aisle</p>	<p>Detailed recording of all results should be made in Task 2b.</p>

<p><b>Evaluation</b></p> <p>The titrations were better with skimmed milk as it is thinner than whole milk. For all the types of milk that were thick I added the same volume of water to each sample of milk to make it thinner and therefore easier to detect the end point. With the yoghurt drinks I added twice the amount of water. I found that the end point was clearer in bright sunshine. On days when there was no sunshine, I used a bright table lamp.</p> <p><i>Critical evaluation for Mark band 3 could include the following points:</i>  <i>Did all the calcium present in milk in whatever form actually react with EDTA.?</i>  <i>Discussion on other methods used to estimate the calcium content?</i>  <i>Accuracy of these methods?</i>  <i>How is the calcium content found for the nutritional labels?</i>  <i>Why use this method?</i></p> <p><i>Further study of why analyse calcium ion content in milk etc. and suitable evaluation is needed for Mark Band 3</i></p> <p>General comments:</p> <p>It must be noted that when the choice of investigation is made the following points should be considered:</p> <ul style="list-style-type: none"> <li>• Does the task offer a sufficient range of different experimental techniques – not a lot of the same (in this investigation – too much repetition of the same techniques – titration)</li> <li>• Is there a link to a vocational context – ask the question what is the reason for completing the experimental work – in this investigation it lends itself to a good link to nutritional values / use of calcium / why different values are needed – this investigation however had too much focus on just the experimental work.</li> </ul>	<p>AO3d Mark Band 1 1 mark</p> <p>In order to increase mark band level, discussion needed on similarity in trends of the experimental results and the nutritional data from one or more sources. Explanation of differences.</p> <p>No mention of nutritional value as stated in the Aim.</p> <p>Difference between calcium and calcium ions not appreciated.</p> <p>To raise mark band level, discussion needed on whether all the calcium containing compounds in milk contain calcium ions.</p> <p>Too vague to merit a mark for AO3e 0 mark.</p> <p>Basic evaluation for mark band 1 could include a discussion on errors In method of investigation used and possible modification of method.</p>
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