**Stage 1 Essential Mathematics**

**Assessment Type 2: Folio**

**Investigate the rate of change of the height**

**The Task**

You are going to investigate how the water level changes as water is added to a container at a constant rate. You will select a range of containers to record the height of water over time and then graph the results. From the behaviour of these graphs you will try to predict what the graph would look like for more complex containers.

**Part 1**

It is difficult to take measurements if water is continuously running into the container (say from a tap), and so you will add water using a small container of known volume (e.g. no larger than a 1/4 cup measure). Start off with a simple container with a constant width for most of its height. Beakers or measuring cylinders that would be available in the science lab would be great for this part of the investigation.

After each measure of water is added, record the height of the water in the container. Continue this process until the container is full or you have reached the point at which the width of the container changes. Record the data in a table like the one below.

|  |  |
| --- | --- |
| Total Volume of water added (ml) | Height (cm)  **h** |
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|  | **V** |
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You will now sketch a graph of the data in the table with volume (ml) on the horizontal axis and height (cm) on the vertical axis.

**Part 2**

Repeat this process for two other containers of constant width, one wider than the original container, one narrower.

Write a discussion about the graphs constructed in Part 1 and Part 2 for the three different containers. How does the width of the container seem to affect the graph?

**Part 3**

Now consider the following containers. Sketch a prediction of the height vs volume graph for each of these containers. Explain your reasoning for the shape of each graph.

**Container A Container B Container C**

**Part 4**

Container C is similar to a conical flask which can be found in the science lab. Using a conical flask take measurements as you did in Part 1, and use these to construct a graph of height vs volume. Discuss the accuracy of your prediction in Part 3 for Container C.

**Part 5 – Optional Extension**

Choose your own container of an interesting shape unlike the ones considered so far (e.g. fancy bottle or vase) and make and test a prediction about what the height vs volume graph would look like. Discuss your results.

**Part 6**

Complete the report outlined below and submit it to your teacher.

**The Report**

**Introduction**

Describe the task in your own words.

**Mathematical Investigations**

Record your results for Parts 1 – 4 (or Parts 1 – 5).

**Discussion**

Explain what relationships you found between the shape of the container and the shape of the graph of height vs volume.

**The report is to be a maximum of 6 A4 pages.**

**Performance Standards Stage 1 Essential Mathematics**

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|  | Concepts and Techniques | Reasoning and Communication |
| **A** | Knowledge and understanding of mathematical information and concepts in familiar and unfamiliar contexts.  Highly effective application of mathematical skills and techniques to find efficient and accurate solutions to routine and complex problems in a variety of contexts.  Gathering, representation, and interpretation of a range of data in familiar and unfamiliar contexts.  Appropriate and effective use of electronic technology to find accurate solutions to routine and complex problems. | Accurate interpretation of mathematical results in familiar and unfamiliar contexts.  Highly effective use of mathematical reasoning to draw conclusions and consider the appropriateness of solutions to routine and complex problems.  Proficient and accurate use of appropriate mathematical notation, representations, and terminology.  Clear and effective communication of mathematical ideas and information to develop logical and concise arguments. |
| **B** | Knowledge and understanding of mathematical information and concepts in familiar and some unfamiliar contexts.  Effective application of mathematical skills and techniques to find mostly accurate solutions to routine and some complex problems in a variety of contexts.  Gathering, representation, and interpretation of data in familiar and some unfamiliar contexts.  Mostly appropriate and effective use of electronic technology to find mostly accurate solutions to routine and some complex problems. | Mostly accurate interpretation of mathematical results in familiar and some unfamiliar contexts.  Effective use of mathematical reasoning to draw conclusions and consider the appropriateness of solutions to routine and some complex problems.  Mostly accurate use of appropriate mathematical notation, representations, and terminology.  Clear and appropriate communication of mathematical ideas and information to develop some logical arguments. |
| **C** | Knowledge and understanding of simple mathematical information and concepts in familiar contexts.  Application of some mathematical skills and techniques to find solutions to routine problems in familiar contexts.  Gathering, representation, and interpretation of data in familiar contexts.  Generally appropriate and some effective use of electronic technology to find solutions to routine problems. | Generally accurate interpretation of mathematical results in familiar contexts.  Appropriate use of mathematical reasoning to draw conclusions and consider the appropriateness of solutions to routine problems.  Generally appropriate use of familiar mathematical notation, representations, and terminology.  Appropriate communication of mathematical ideas and information. |
| **D** | Basic knowledge and some understanding of simple mathematical information and concepts in some familiar contexts.  Application of basic mathematical skills and techniques find partial solutions to routine problems in some contexts.  Some gathering, representation, and basic interpretation of simple data in familiar contexts.  Some appropriate use of electronic technology to find solutions to routine problems. | Some interpretation of mathematical results in some familiar contexts.  Attempted use of mathematical reasoning to consider the appropriateness of solutions to routine problems.  Some use of familiar mathematical notation, representations, and terminology.  Attempted communication of simple mathematical ideas and information. |
| **E** | Limited knowledge or understanding of mathematical information or concepts.  Attempted application of basic mathematical skills or techniques, with limited accuracy in solving routine problems.  Some gathering and attempted representation of simple data in a familiar context.  Attempted use of electronic technology in to find a solution to a routine problem. | Limited interpretation of mathematical results.  Limited awareness of the use of mathematical reasoning in solving a problem.  Limited use of mathematical notation, representations, or terminology.  Attempted communication of an aspect of mathematical information. |