Name: **Final Grade: C**

Performance Standards for Stage 1 Essential Mathematics- Rate of Change Investigation.

	Concepts and Techniques	Reasoning and Communication
A	Knowledge and understanding of mathematical information and concepts in familiar and unfamiliar 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. 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. 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. 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. 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. 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. 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. 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. Some gathering and attempted representation of simple data in a familiar context. Attempted use of electronic technology to find a solution to a routine problem.	Limited interpretation of mathematical results. Limited use of mathematical notation, representations, or terminology. Attempted communication of an aspect of mathematical information.

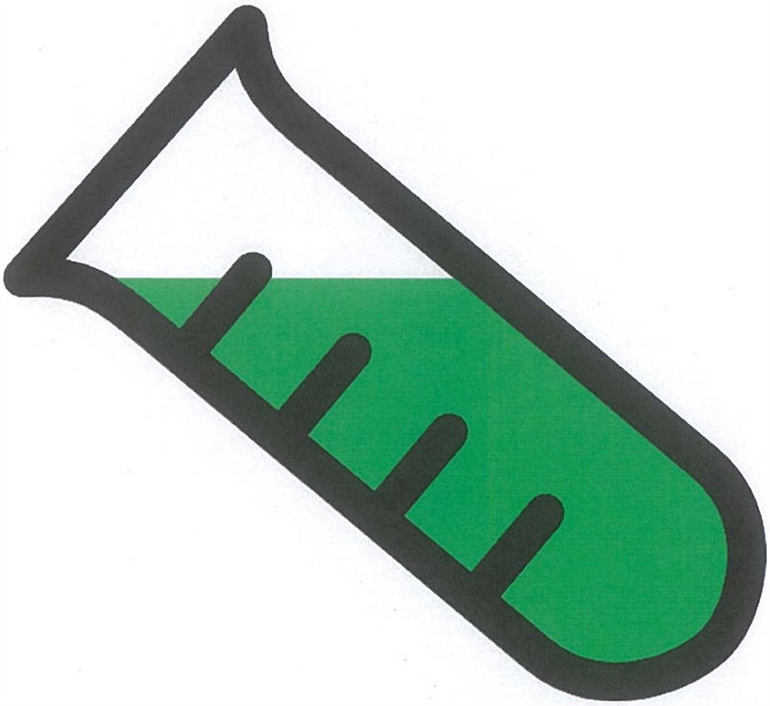
Ref: A1013818

Comments:

- Be mindful to include all steps in your method
- Some refinement of your ideas is required with your analysis of the water level with your beaker. Review the feedback on the attached document to get a better idea of what I am referring to.
- Use of technology is strong -graphs are all formatting well. Be mindful that the volume of water added is measured in mL and not mm.
- Rate of change calculations done correctly but ensure you state the formula and what you are substituting in for beforehand ie (change in height / volume of water added).
- Your description and interpretation of your graphs need a little refinement.
- Nice presentable report -nicely formatted. Committed effort

Investigate the rate of change of the height

Stage 1 Essential Mathematics



AIM

The aim for the investigation was to see whether the water would increase in the objects; beaker, measuring cylinder, conical flask and a takeaway container.

Commented [BM1]: Water level...
Link to rates – does the rate of change (cm/mL) change when a fixed amount of water (30mL) is added to different containers.

INTRODUCTION

This investigation looks at how the water level changes when a constant amount of water is applied to an object. A numerous amount of objects will be measuring the height of water over time and graph the results. The graphs will be predicted as to what they'll look like for more complex objects based on the behaviour of these graphs.

Commented [BM2]: Review and rephrase.

METHOD

1. A ruler, beaker, measuring cylinder, conical flask, smaller measuring cylinder and takeaway container were all collected and place on the bench at each station.
2. Water was placed into the smaller measuring cylinder with 30mL measured by a ruler.
3. The water from the measuring cylinder was poured into the beaker.
4. Every 30mL the volume was increased with water.
5. This step was then continued through measuring cylinder, conical flask and takeaway container.

Commented [BM3]: We used the measurements on the cylinder itself to get 30mL not a ruler.

Commented [BM4]: Height was measured using a ruler on the beaker...

Commented [BM5]: Until we got to 300mL.

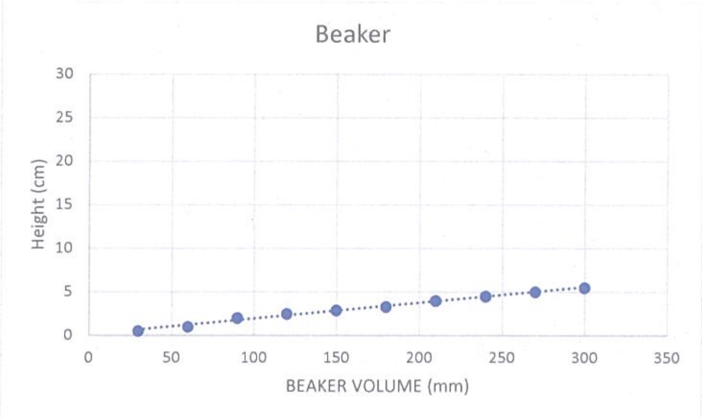
Commented [BM6]: Steps 2-4 was repeated to 300mL

MATERIALS

- Beaker
- Measuring cylinder (large)
- Measuring cylinder (small)
- Conical flask
- Ruler
- Takeaway container

PART 1 (BEAKER)

Beaker Volume (mm)	Height (cm)
30	0.5cm
60	1cm
90	2cm
120	2.5cm
150	2.9cm
180	3.3cm
210	4cm
240	4.5cm
270	5cm
300	5.5cm



- **Is it a straight line or does it change direction (why/why not)?**

The graph above is a straight line but increases at the end because the beaker's shape becomes wider. The increase of the water becomes smaller rapidly.

- **How steep is it (suggest why)**

There is a small incline in the beaker graph. At the start of the experiment the graph becomes steep almost in steadily, this is the reason as to the shape of the beaker stays the same shape but changes its width a little making the steepness to increase.

Commented [BM7]: We never reached the very tip of the beaker. Only 300mL was added. If the beaker got wider... what do you reckon would happen to the height? It's the opposite to what you have stated.

Commented [BM8]: This is the reason but its wide so the water level will not increase dramatically.

RATE OF CHANGE

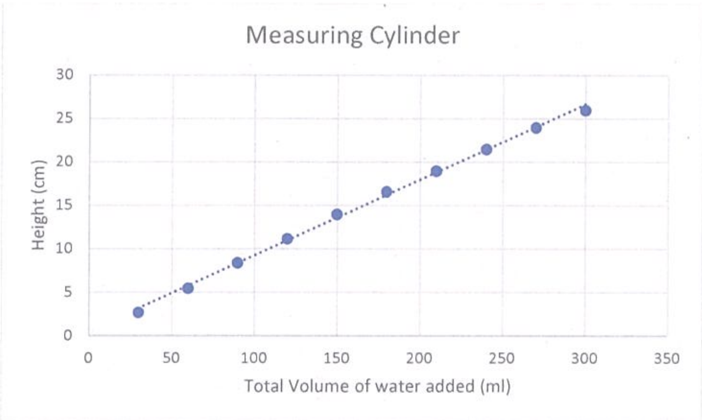
Commented [BM9]: Good – state your formula first though before substituting in your values.

$$\frac{5.5(cm)}{300(mL)} = 0.0183cm/mL$$

Ref: A1013818

PART 2 (MEASURING CYLINDER)

Total Volume of water added (ml)	Height (cm)
30	2.7cm
60	5.5cm
90	8.4cm
120	11.2cm
150	14cm
180	16.6cm
210	19cm
240	21.5cm
270	24cm
300	26cm



- **Is It a straight line or does it change direction (why/why not)?**

As you can see from the graph above you can tell that the measuring cylinder kept its one shape. The shape of the measuring cylinder is long and skinny this makes the rate of the water being poured into it to keep a straight line and increase its steepness because the mass of the cylinder isn't that big.

- **How steep is It (suggest why)**

The measuring cylinder starts to increase throughout the whole experiment. The water that is poured into the measuring cylinder stays at the same rate throughout the whole time the water is being poured into the cylinder.

Commented [BM10]: Be careful of wording – use width of the cylinder, not mass.

Your ideas need to be refined a little here.

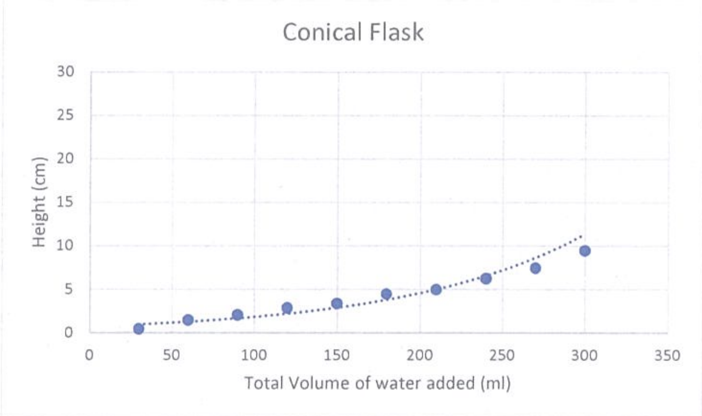
Commented [BM11]: This needs fixing – do you mean the water level increases at a constant rate?

RATE OF CHANGE

$$\frac{26(cm)}{300(mL)} = 0.086cm/mL$$

Part 2(b) (CONICAL FLASK)

Total Volume of water added (ml)	Height (cm)
30	0.5cm
60	1.5cm
90	2.1cm
120	2.9cm
150	3.4cm
180	4.5cm
210	5cm
240	6.3cm
270	7.5cm
300	9.5cm



- **Is it a straight line or does it change direction (why/why not)?**

The trendline in the graph above changes directions a little from when it first started. The particular reason for this is the way that the conical flask is designed. As the water risers the water being poured into the conical flask has less room as the top of the conical flask gets skinner, impacting the amount of water that's able to be held within the item.

Commented [BM12]: Good.

- **How steep is it (suggest why)**

At the start of the graph, it isn't steep at all. As soon as the conical flask starts to change its shape the increase of the steepness of the height of the water becomes more swiftly.

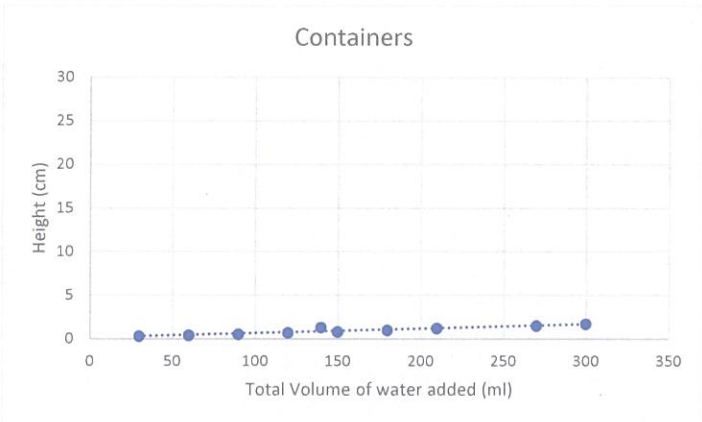
Commented [BM13]: Steepness changes. Starts off low and then increases.

RATE OF CHANGE

$$\frac{9.5(cm)}{300(mL)} = 0.0316cm/mL$$

PART 3 (CONTAINERS)

Total Volume of water added (ml)	Height (cm)
30	0.3cm
60	0.4cm
90	0.5cm
120	0.7cm
150	0.8cm
180	1cm
210	1.2cm
140	1.3cm
270	1.5cm
300	1.7cm



- **Is it a straight line or does it change direction (why/why not)?**

The graph above indicates to the viewer that the container was one fixed shape. Towards the end of the container the width gets the tiniest bit bigger. Increasing the trendline to go up slightly.

- **How steep is it (suggest why)**

In this graph it is not steep anytime of the experiment. There was no dramatic change of shape within the container, resulting there to be no change of direction and the water to stay the same throughout the whole thing.

Commented [BM14]: Why is this? Explain why...

If you look closely the takeaway container actually isn't a fixed shape. It slightly gets wider.

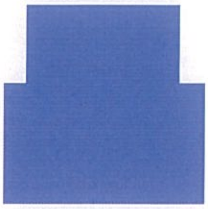
Commented [BM15]: Explain why.

RATE OF CHANGE

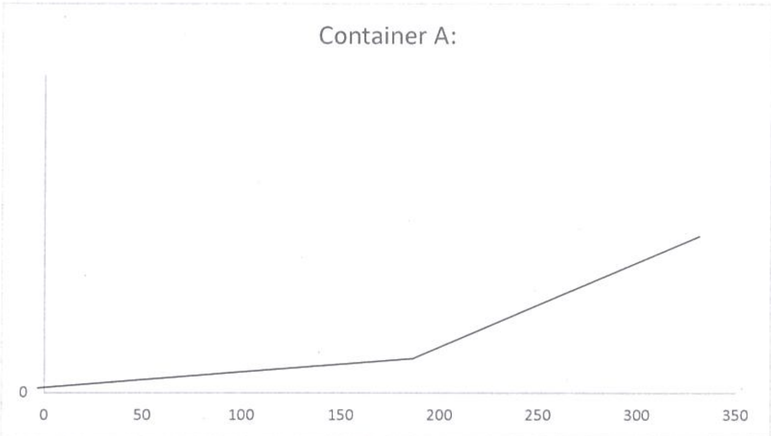
$$\frac{1.7(cm)}{300(mL)} = 000.56cm/mL$$

Commented [BM16]: Look at this again.

PART 3 EXTENSION



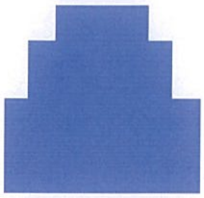
CONTAINER A



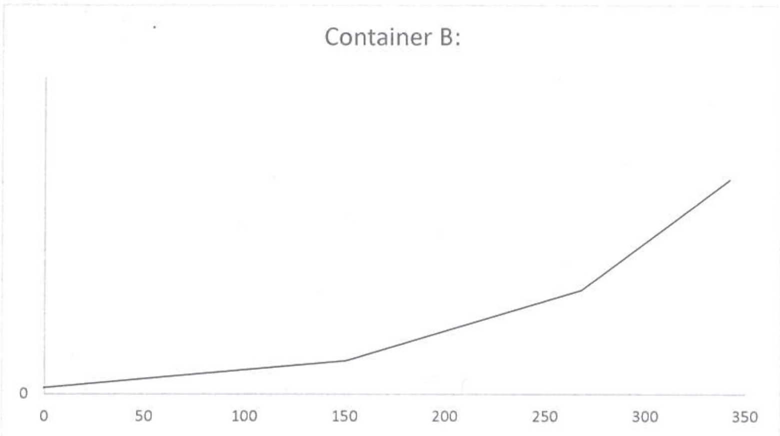
WHY DOES IT LOOK LIKE THIS?

Container A's graph goes straight until it reaches where the object changes shape, resulting the graph to increase. Having the object change into a smaller shape effects the rate of the water being collected in the object. As the item becomes smaller, it makes the amount of water being poured into the container, less. This is the reason as the smaller the object is the less of water that's is allowed to fit.

PART 3 EXTENSION



CONTAINER B



WHY DOES IT LOOK LIKE THIS?

Same thing as container A which changes its shape, container B is a little different as they are more changes of the shape of the container. The graph above shows when the container begins to change the direction of the object and the results start to increase.

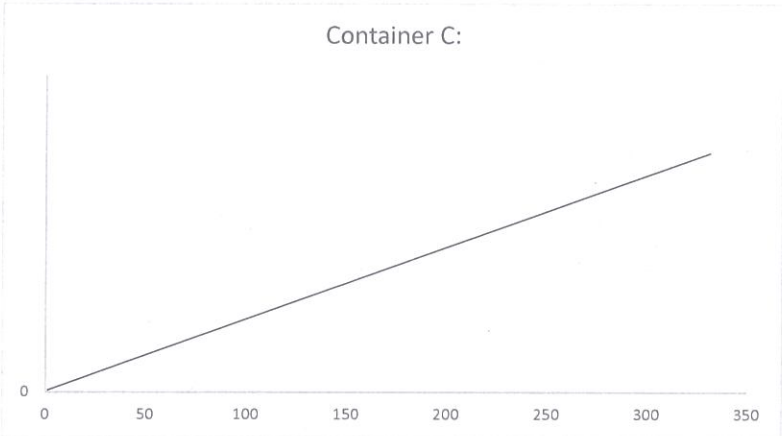
Commented [BM17]: Water level rate increases twice.

Ref: A1013818

PART 3 EXTENSION

Commented [BM18]: This would be curvy and not a straight line.

CONTAINER C



WHY DOES IT LOOK LIKE THIS?

The reason as to why the graph for container C looks like this, is, because the bottom of the container is wide and as the water rises the container becomes skinny. Comparing this container shape to container A and B they both have different shapes that change within the individual object, causing the graph to not be straight. Whereas container C is one straight shape the graph is obviously going to be straight.

Ref: A1013818

DISSCUSION

Container	Rate of Change
Beaker	$0.0183 cm/mL$
Measuring Cylinder	$0.086 cm/mL$
Conical Flask	$0.0316 cm/mL$
Extension	$000.56 cm/mL$

Commented [BM19]: Be careful with this answer. This is wrong.

When was the graph at its steepest? How does this compare to rate of change?

The measuring cylinder was the steepest graph as the cylinder is shaped skinny and doesn't have much room within it. Resulting the water to have less room to spread out increasing the steepness of the graph.

Commented [BM20]: Good.

When was the graph a curve? Why?

The only graph in this experiment that was curved was the conical flask. The reason as to why the conical flask has a curve in the diagram, is because the way the conical flask is designed. Having the shape of the flask dramatic change its shape from wide to skinny making the graph exponential.

Commented [BM21]: Continuously becomes skinnier and therefore will produce a curved line as the water level height is constantly changing.

When did the graph change direction? What caused this to occur?

The cause of one of the graphs changing its direction is because of the particular shape of the object. When the object's shape changes, e.g., wider, smaller, the trendline with change as the object is getting either more water in it or less, all depending on what the shape changes into.

Discuss any difficulties you experienced while undertaking the practical component:

Considering the information provided in the following there is no feedback for the practical component.

Consider the potential errors that could affect the accuracy of the results:

Firstly, when pouring the water into the smaller measuring cylinder and measuring it to make sure there was 30mL within it. The individual measuring to see if its right or not could have messed it up and didn't realise there was more or less of water being poured into the objects.

What improvements could be suggested if the experiment were to be repeated?

Some improvements that could possibly be suggest if the experiment were to be repeated, repeating the experiments more than once. Repeating the experiment several times will make the data more reliable, and have the opportunity to see which data sample was the best.

CONCLUDING STATEMENT

In conclusion, the aim for the investigation was to see whether the water would increase in the objects; beaker, measuring cylinder, conical flask and takeaway container. That was completed through numerous experiments that found that the conical flask was the most curve trendline, this was because of the way it's shaped, at the bottom it is wide then as It goes it up, it gets skinny. Next, the steepest was the measuring cylinder due to the way its shaped and how it's fixed in one shape and doesn't have as much mass as the other objects.

Commented [BM22]: Review.

APPENDIX