Name: _____

Quadratic Functions

Directions: Groups of two or three students are required for this activity. Part 1 of this activity must be submitted today. Part 2 will be due at a later date. Though you must work together to gather the data, each student is responsible for his/her own work.

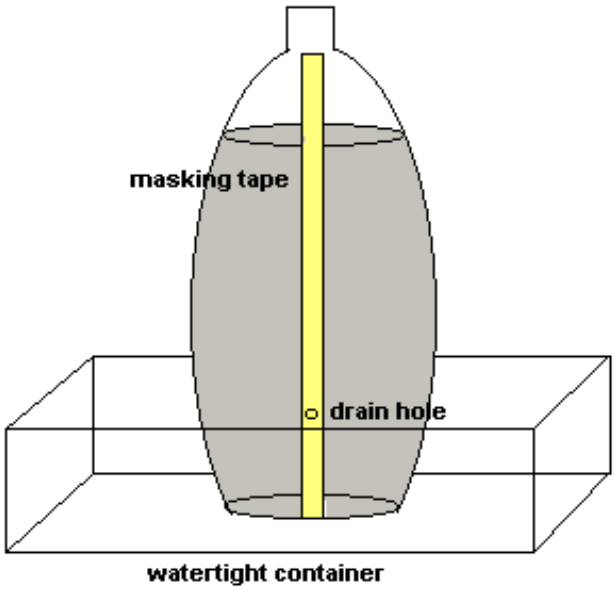
Purpose:

1. To understand better the quadratic equation
2. To recognize a possible quadratic curve
3. To generate a quadratic model from data collected using technology

Materials: large plastic soda bottle, masking tape, pen or pencil, metric ruler, stopwatch, water, large bowls (or other water tight container)

Equipment Setup:

1. Remove the cap of soda bottle.
2. Attach a piece of masking tape vertically from the bottom to the top of the bottle as shown.
3. Note that there is a small hole in the bottle about 5cm from the bottom of the bottle.
4. Put a piece of tape over this hole.
5. Fill the bottle with water.
6. Place the bottle in the bowl as shown.



Experiment Procedure:

You will be recording water height every 5 seconds by marking the water height on the masking tape.

1. Clearly mark the starting water height on the masking tape.

2. When ready to begin, pull off the tape that is covering the hole and simultaneously begin the timing.

3. After 5 seconds, one group member will signal the end of that time interval by saying "mark" and the other group member will mark the current water height on the masking tape.

4. Continue until the water level reaches zero (the level of the drain hole).

5. Remove the tape from the bottle and measure the water height (in millimeters) at each 5-second interval. **Remember the water height is defined as the distance FROM the drain hole**. Stated another way, your table should reflect what actually happened during the experiment.

Complete the table. Extend the table, if necessary.

time (sec)	0								
water height (mm)									

time (sec)									
water height (mm)									

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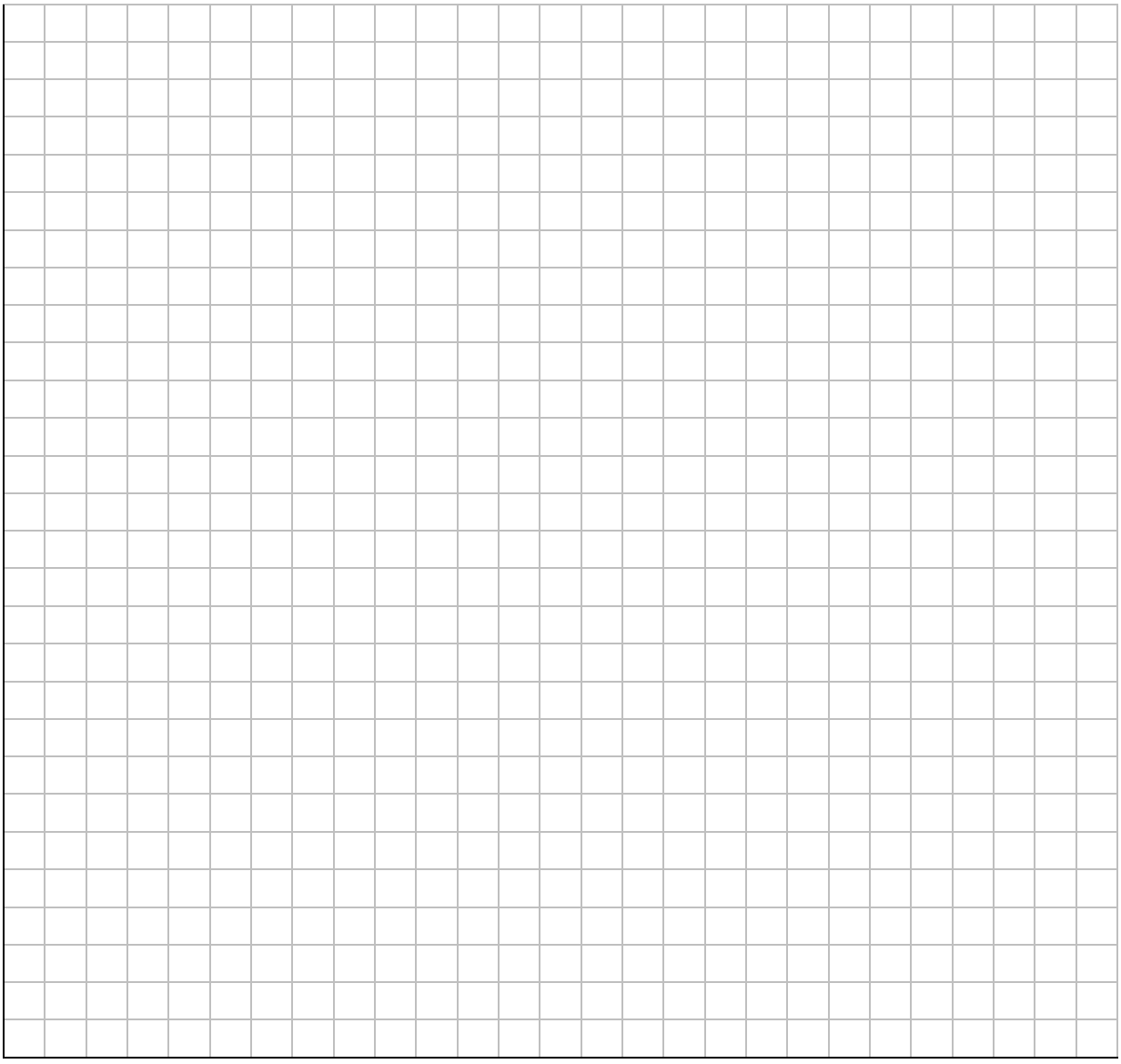
Lab 2: Quadratic Functions (Part 1 – in class)

Graphical Analysis:

Graphically sketch the mathematical model. Assume the model to be quadratic in nature.

1. Let time be your *x* values and water height be your *y* values.
2. Select appropriate scales and label the *x* and *y* axes
3. Mark each data point on the graph.
4. Sketch a **quadratic** graph to model the data points.



Questions:

1. Look at the quadratic graph you sketched to model the data points. What is the *y*-intercept? State your answer as an *xy*-coordinate point. What does the *y*-intercept represent? Explain briefly.

2. Look at the quadratic graph you sketched to model the data points. What is the x-intercept? State your answer as a *xy*-coordinate point. What does the *x*-intercept represent? Explain briefly.

3. If you were to extend your quadratic graph into a full parabola, would the parabola open up or open down?

4. If the starting water height were **20 mm lower** than in your experiment, would it take more or less time for the water level to reach zero (the level of the drain hole)? Why? Would this affect the *x*-intercept? If yes, how?

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Lab 2: Quadratic Functions (Part 2 – take home)

Analysis tools like Microsoft Excel can determine mathematical models very quickly. Your goal for this assignment is to use Microsoft Excel to graph the data and determine both a quadratic model and a linear model for the data.

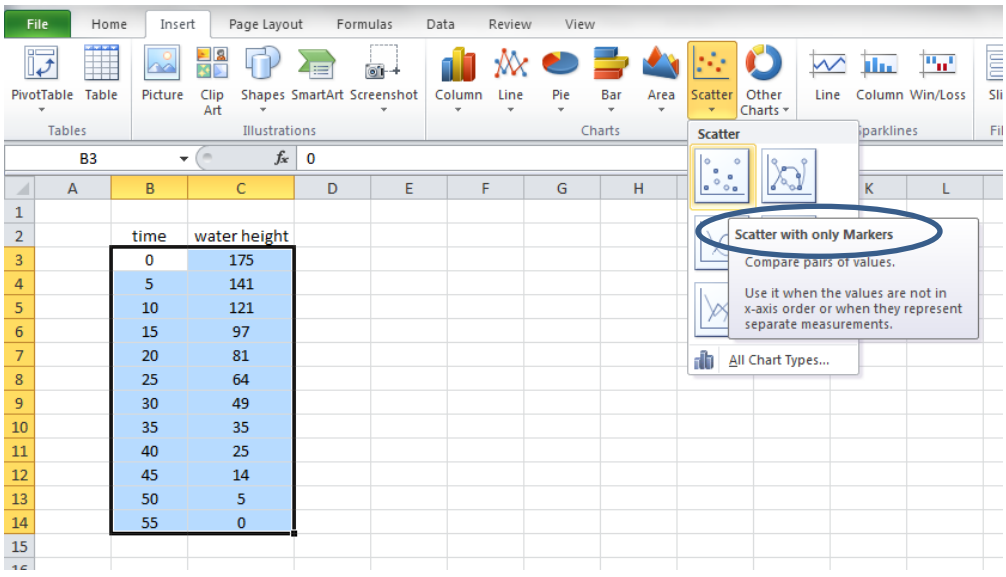
	A	B	C
1			
2		time	water height
3		0	175
4		5	141
5		10	121
6		15	97
7		20	81
8		25	64
9		30	49
10		35	35
11		40	25
12		45	14
13		50	5
14		55	0

<u>Scatterplot</u>:

1. Open Microsoft Excel and enter the data in two columns: time (seconds) and water height (millimeters).

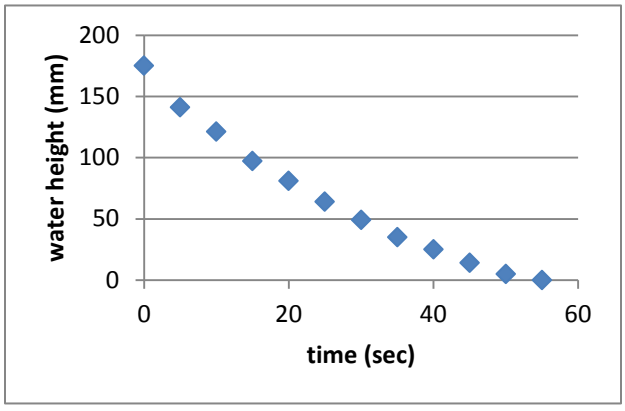
2. Create a scatterplot of the data.

   With your mouse, highlight all the data. On the **Insert** tab select **Scatter** (Scatter with only Markers). A scatterplot of time v. water height should appear.

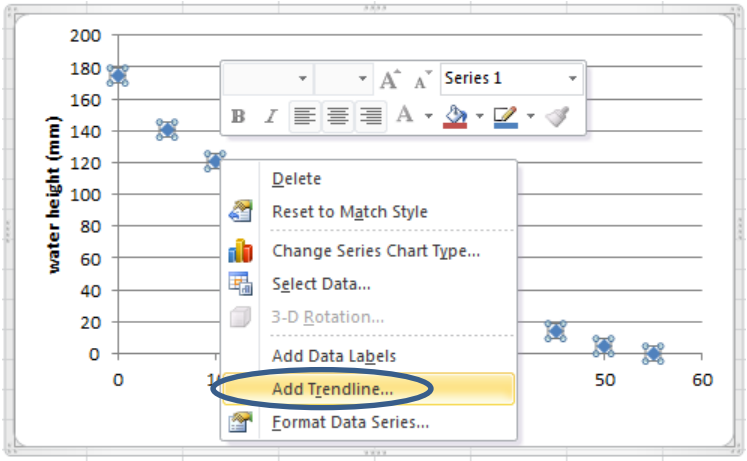


3. Add axis titles for both the *x* and *y* axes.

   On the **Layout** tab select **Axis Titles** and make the horizontal axis title "time (sec)" and the vertical axis title "water height (mm)."



Quadratic Model:



4. Add a quadratic trendline to the graph.

    - Right-click on one of the data points in the scatterplot and select **Add Trendline**.
    - Under **Trend/Regression Type**, select **Polynomial** and make sure the **Order** is set at **2**.
    - At the bottom, check the box for **Display Equation on Chart** and then click **Close.**
    - A quadratic trendline (quadratic model) should now appear on your scatterplot.

5. Print the graph and submit it with this assignment.

Linear Model:

6. Create a linear trendline on the graph.

    - Right-click on one of the data points in the scatterplot and select **Add Trendline**.
    - Under **Trend/Regression Type**, select **Linear** and make sure the box for **Display Equation on Chart** is checked and then click **Close.**
    - A linear trendline (linear model) should now appear on your scatterplot.

7. Print the graph and submit it with this assignment.

Follow-up:

Write a paragraph comparing and contrasting the quadratic and the linear models. Which better models the data? Why?

Reflection:

Write a paragraph describing this experiment and what you learned about modeling real world phenomena. What do the data and the mathematical model you found in class tell you about the rate at which the water flows from the bottle? Is it constant or does it change and if it changes, how?