In this activity we’ll review how to use our knowledge of to determine a formula relating two variables with a simple relationship. Then we will learn how we can apply this knowledge to discover formulas between two variables with a complex relationship.

|  |  |
| --- | --- |
| Time (s) | Position (m) |
| 0 | .22 |
| 1 | .31 |
| 2 | .40 |
| 3 | .51 |
| 4 | .59 |

**1. Review**

Here is some data for a toy car’s position and time:

1. Plot the data above with time on the horizontal axis and position on the vertical. Make a trendline in your graph.
2. Use the trendline to make an equation for the car’s position *X* in terms of time *T*. Write your equation below:

**2. One Kind of Special Curve**

|  |  |  |
| --- | --- | --- |
| Diameter (cm) | Mass (g) |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

Measure the diameter and mass of several solid circles. Record your data in the table below:

1. Plot the data above with diameter on the horizontal axis and mass on the vertical. Draw a smooth curve on your graph that shows the pattern in the data.
2. Look at your table. When the circle diameter of is doubled, by what factor does the mass change? Do you have any rows where one diameter is triple the other? If so, by what factor does the mass change?
3. Maybe you have seen a graph in math class with a similar shape. If so, what is its name? What formula in math class has this shape? (Use *x* and *y* in your answer for the formula.)
4. At the top of the third, blank column in the table, write “Diameter squared (cm2)”. Fill in the corresponding rows with the squares of the values in your diameter column.
5. Make a new graph of mass (g) vs. diameter2 (cm2) with mass on the vertical axis. Draw a trendline. Find the equation of the line and report it below:
6. Replace x and y in your trendline equation with D2 and M. Write your corrected equation below:
7. Use your equation to predict the mass of a 12.5 cm diameter disk. On each graph plot this point. Then obtain this disk from your teacher and measure its mass. Report your prediction and your measurement below:

**3. Another Special Curve**

On the last page of the handout measure the length and width of each paragraph. Record your data in the table below:

|  |  |  |
| --- | --- | --- |
| Width (cm) | Height (cm) |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

1. Plot the data above with width on the horizontal axis.
2. Look at your data. When the width doubles, what happens to length? When the width triples what happens to length?
3. Maybe you have seen a graph in math class with a similar shape. If so, what is its name? What formula in math class has this shape? (Use *x* and *y* in your answer.)
4. Based on your answers above, fill out the third column with entries that are calculated from the width column and give that column an appropriate title.
5. Plot the height vs the new column. (New column is the horizontal axis. Use the trendline to make an equation for the paragraph height *H* in terms of its width *W*. Write your equation below:
6. What are the units of the slope of your trendline? What does this slope mean?

**Recap:**

The first special curve is a **parabola.** If two variables and have this sort of relationship, is proportional to: Doubling doubles , quadrupling quadruples . If doubles, quadruples, so doubling, quadruples . **If were to increase tenfold how would change?**

We can write this relationship as: . Plotting : vs gives a curve. Plotting vs gives a line with slope m.

The second special curve is a **hyperbola.** If two variables and have this sort of relationship, is proportional to: Doubling doubles , quadrupling quadruples . If doubles halves, so doubling halves . **If were to increase tenfold how would change?**

We can write this relationship as: . Plotting : vs gives a curve. Plotting vs gives a line with slope m.

**Bonus:**

A student suspects that a certain toy car’s movement depends on time in the following manner:

where how many seconds since the car has been on and is the distance it has traveled. The symbol is some constant related to the number of batteries in the toy.

1. If her data fits this formula, what would she graph in order to make a linear plot?
2. What should be the slope of the trendline in that plot be? What are its units? What should the y-intercept be?