Honors Algebra 2 Name: _____

NOTES: Linear, Quadratic, and Exponential Regression (using a calculator)

## Writing Equations to Model Data

When data have equally-spaced inputs, you can analyze patterns in the differences of the outputs to determine what type of function can be used to model the data. Linear data have constant *first differences*. Quadratic data have constant *second differences*. The first and second differences of $f(x) = x^2$ are shown below.

Equally-spaced $x$-values

| $x$ | −3 | −2 | −1 | 0 | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|
| $f(x)$ | 9 | 4 | 1 | 0 | 1 | 4 | 9 |
| first differences: | | −5 | −3 | −1 | 1 | 3 | 5 |
| second differences: | | | 2 | 2 | 2 | 2 | 2 |

### Example 1: Decide if the data represents a linear or quadratic function.

**MODELING WITH MATHEMATICS** The table shows the distances $y$ a motorcyclist is from home after $x$ hours.

| Time (hours), $x$ | 0 | 1 | 2 | 3 |
|---|---|---|---|---|
| Distance (miles), $y$ | 0 | 45 | 90 | 135 |

**a.** Determine what type of function you can use to model the data. Explain your reasoning.

**b.** Write and evaluate a function to determine the distance the motorcyclist is from home after 6 hours.

### Example 2: Decide if the data represents a linear or quadratic function.

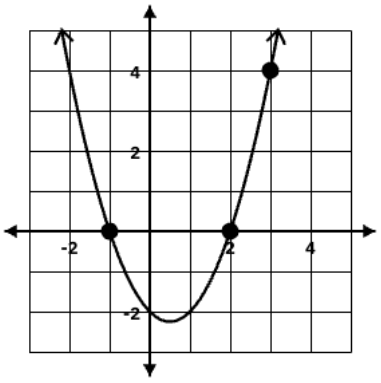
**MODELING WITH MATHEMATICS** A baseball is thrown up in the air. The table shows the heights $y$ (in feet) of the baseball after $x$ seconds. Write an equation for the path of the baseball. Find the height of the baseball after 5 seconds.

| Time, $x$ | 0 | 2 | 4 | 6 |
|---|---|---|---|---|
| Baseball height, $y$ | 6 | 22 | 22 | 6 |

Example 3: Write the quadratic function in standard form. Use the function to find the coordinates of the vertex.

Write an equation of the parabola that passes through the points $(-1, 4)$, $(0, 1)$, and $(2, 7)$.

Example 4: Write the quadratic function in standard form. Use the function to find $(-3,\quad)$ and $(5,\quad)$.




Example 5:

The table shows the estimated profits $y$ (in dollars) for a concert when the charge is $x$ dollars per ticket. Write and evaluate a function to determine what the charge per ticket should be to maximize the profit.

| **Ticket price, *x*** | 2 | 5 | 8 | 11 | 14 | 17 |
|---|---|---|---|---|---|---|
| **Profit, *y*** | 2600 | 6500 | 8600 | 8900 | 7400 | 4100 |

Example 6:

The table shows the results of an experiment testing the maximum weights $y$ (in tons) supported by ice $x$ inches thick. Write a function that models the data. How much weight can be supported by ice that is 22 inches thick?

| **Ice thickness, *x*** | 12 | 14 | 15 | 18 | 20 | 24 | 27 |
|---|---|---|---|---|---|---|---|
| **Maximum weight, *y*** | 3.4 | 7.6 | 10.0 | 18.3 | 25.0 | 40.6 | 54.3 |