4-3 Modeling With Quadratic Functions

Vocabulary

**Review**

1. Cross out the graphs that are NOT parabolas.

![Graphs](image)

**Vocabulary Builder**

**model** *(verb)* MAH duhl

**Main Idea:** Modeling is a way of using math to describe a real-world situation.

**Definition:** A function or equation models an action or relationship by describing its behavior or the data associated with that relationship.

**Example:** The equation \( a = 3g \) models the relationship between the number of apples, \( a \), and the number of oranges, \( g \), when the number of apples is triple the number of oranges.

**Use Your Vocabulary**

Draw a line from each description in Column A to the equation that models it in Column B.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. The string section of the orchestra has twice as many violins as cellos.</td>
<td>( y = 2x + 1 )</td>
</tr>
<tr>
<td>3. There are two eggs per person with one extra for good measure.</td>
<td>( y = 100 - 2x )</td>
</tr>
<tr>
<td>4. There were 100 shin guards in the closet, and each player took two.</td>
<td>( y = 2x )</td>
</tr>
</tbody>
</table>
Problem 1 Writing an Equation of a Parabola

Got It? What is the equation of a parabola containing the points (0, 0), (1, –2), and (–1, –4)?

5. Substitute the three points one at a time into \( y = ax^2 + bx + c \) to write a system of equations.

Use (0, 0).

\[ \square = a(\square)^2 + b(\square) + c \]

Use (1, –2).

\[ \square = a(\square)^2 + b(\square) + c \]

Use (–1, –4).

\[ \square = a(\square)^2 + b(\square) + c \]

6. Solve the system of equations.

7. The equation of the parabola is \( y = \square x^2 + \square x + \square \).

Problem 2 Using a Quadratic Model

Got It? The parabolic path of a thrown ball can be modeled by the table. The top of a wall is at (5, 6). Will the ball go over the wall? If not, will it hit the wall on the way up, or the way down?

8. Circle the system of equations you find by substituting the three given points that are on the parabola.

\[
\begin{align*}
1 &= 9a + 3b + c \\
2 &= 25a + 5b + c \\
3 &= 36a + 6b + c \\
3 &= a + b + c \\
5 &= 2a + 2b + c \\
6 &= 9a - 3b + c \\
5 &= 4a + 2b + c \\
6 &= 9a + 3b + c
\end{align*}
\]

9. Now, solve the system of equations.

10. The solution of the system is \( a = \square \), \( b = \square \), \( c = \square \).

11. The quadratic model for the ball’s path is \( \square \).

12. How can you determine whether the ball goes over the wall? Place a √ if the statement is correct. Place an X if it is not.

- [ ] The value of the model at \( x = 5 \) is at least 6.
- [ ] The value of the model at \( x = 6 \) is at least 5.
13. Will the ball go over the wall? Explain.

__________________________________________________________________________

Problem 3 Using Quadratic Regression

Got It? The table shows a meteorologist’s predicted temperatures for a summer day in Denver, Colorado. What is a quadratic model for the data? Predict the high temperature for the day. At what time does the high temperature occur?

14. The slope of the model \( y = 5 \) is less than the slope of the model \( y = 5 \), therefore the ball was on its way down / up. Is it hedged the wall?

15. Using the LIST feature on your calculator, identify the data that you will enter.

<table>
<thead>
<tr>
<th>Time</th>
<th>Temperature (°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 A.M.</td>
<td>63</td>
</tr>
<tr>
<td>9 A.M.</td>
<td>76</td>
</tr>
<tr>
<td>12 P.M.</td>
<td>86</td>
</tr>
<tr>
<td>3 P.M.</td>
<td>89</td>
</tr>
<tr>
<td>6 P.M.</td>
<td>85</td>
</tr>
<tr>
<td>9 P.M.</td>
<td>76</td>
</tr>
</tbody>
</table>

16. Using 24-hour clock, write the values for the L₁ column.

<table>
<thead>
<tr>
<th>Time</th>
<th>L₁</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 a.m.</td>
<td>63</td>
</tr>
<tr>
<td>9 a.m.</td>
<td>76</td>
</tr>
<tr>
<td>12 p.m.</td>
<td>86</td>
</tr>
<tr>
<td>3 p.m.</td>
<td>89</td>
</tr>
<tr>
<td>6 p.m.</td>
<td>85</td>
</tr>
<tr>
<td>9 p.m.</td>
<td>76</td>
</tr>
</tbody>
</table>

17. Circle the calculator screen that shows the correct entry.

18. Enter the data into your calculator. Use the QuaReg function. Your screen should look like the one to the right.

Write the quadratic model for the data.
19. Use your calculator to find the maximum value of the model. The vertex of the parabola is (______, ______).

20. The high temperature will be ___ °F.

21. At what time will the high temperature occur?

---

**Lesson Check**  
**Do you UNDERSTAND?**

**Error Analysis** Your classmate says he can write the equation of a quadratic function that passes through the points (3, 4), (5, 2), and (3, 0). Explain his error.

22. Graph the points (3, 4), (5, 2), and (3, 0).

23. Underline the correct words to complete the rule for finding a quadratic model.

   Two / Three noncollinear points, no two / three of which are in line horizontally / vertically, are on the graph of exactly one quadratic function.

24. What is your classmate’s error?

---

**Math Success**

Check off the vocabulary words that you understand.

☐ model  ☐ quadratic model

Rate how well you can use a quadratic model.