# Algebra 1
## Unit 7 – Quadratic Functions

<table>
<thead>
<tr>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
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<tbody>
<tr>
<td>Mar 2</td>
<td>A Day</td>
<td>3</td>
<td>B Day</td>
<td>4</td>
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<tr>
<td><strong>Quadratic Parent Function Characteristics</strong></td>
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<tr>
<td>– Find the AOS, vertex, roots/zeros/x-intercepts/solutions</td>
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<td>– go between forms (standard to vertex and vice versa)</td>
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<tr>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td><strong>Graphing Quadratics</strong></td>
<td></td>
<td><strong>Transformations</strong></td>
</tr>
<tr>
<td>– standard form</td>
<td></td>
<td>– parent function</td>
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<tr>
<td>– vertex form</td>
<td></td>
<td>– domain and range</td>
</tr>
<tr>
<td>– using a table</td>
<td></td>
<td>(verbal, graphs, tables, EQs)</td>
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<tr>
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<td>– changes to a, b, c and d</td>
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<td>16</td>
<td>B Day</td>
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<td>A Day</td>
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<td>18</td>
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<td>A Day</td>
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<td>20</td>
<td>B Day</td>
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<tr>
<td><strong>Transformations</strong></td>
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<td><strong>Solve Quadratics by Factoring</strong></td>
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<tr>
<td>– parent function</td>
<td></td>
<td>– from tables</td>
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<tr>
<td>– domain and range</td>
<td></td>
<td>– from graphs</td>
<td></td>
</tr>
<tr>
<td>(verbal, graphs, tables, EQs)</td>
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<tr>
<td>– changes to a, b, c and d</td>
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<table>
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<tr>
<th>23</th>
<th>A Day</th>
<th>24</th>
<th>B Day</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Solve Quadratics with the Quadratic Formula</strong></td>
<td></td>
<td></td>
<td>Elaboration Day</td>
</tr>
<tr>
<td>– decimal and exact solutions</td>
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<td></td>
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<table>
<thead>
<tr>
<th>25</th>
<th>A Day</th>
<th>26</th>
<th>B Day</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Elaboration Day</strong></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>27</th>
<th>A Day</th>
<th></th>
<th></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>30</th>
<th>B Day</th>
<th>31</th>
<th>A Day</th>
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<tbody>
<tr>
<td>EOC 9th Grade English</td>
<td></td>
<td><strong>Test – Teacher Test</strong></td>
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<table>
<thead>
<tr>
<th>April 1</th>
<th>B Day</th>
<th>2</th>
<th>A Day</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Start Unit 7 – Part 2</strong></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>3</th>
<th></th>
<th></th>
<th>No School</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>A Day</td>
<td>April 1</td>
<td>Bad Weather Day</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>
1. A rocket was launched into the air and the graph below shows the height of the rocket over time. Answer the questions below the graph.

- How long was the rocket in the air?
- At what height was the rocket launched?
- What was the maximum height of the rocket?
- When did the rocket reach its maximum height?
- Identify the domain and range.

2. What is the volume of a rectangular prism with length $4x^2y$, width $3xy^6$, and height $6x^4y^2$?

3. Which equation represents the line shown?

   - A. $y = -\frac{1}{2}x - 2$
   - B. $y = -2x - 2$
   - C. $y = \frac{1}{2}x - 2$
   - D. $y = -\frac{1}{2}x + 4$
Analyzing Graphs of Quadratic Functions

Explore – Roller Coaster Ride

A roller coaster at XTRA Fun Rides goes into an underground tunnel during the first descent of the ride. The graph below represents the height of the roller coaster versus the time passed since the initial drop. Use this information to label the graph, including the following:

- a title
- labels for the x and y-axes
- indicate the scale for each axis
- identify the x-intercepts, y-intercepts, and vertex

Use the graph to complete the table.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Coordinates of the point(s)</th>
<th>Describe the point(s) on the graph</th>
<th>Meaning of the point(s) in context</th>
</tr>
</thead>
<tbody>
<tr>
<td>y-intercept</td>
<td>(0, ____ )</td>
<td>Where the graph crosses the _______</td>
<td>The y-intercept is the height of the roller coaster at ________________</td>
</tr>
<tr>
<td>x-intercept(s)</td>
<td>(<strong><strong>, 0) &amp; (</strong></strong>, 0)</td>
<td>Where the graph crosses the _______</td>
<td>The x-intercept is when the roller coaster ____________________________</td>
</tr>
<tr>
<td>vertex</td>
<td>(____, ____ )</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Notes – Introduction to Quadratics

- Quadratic function:

**EX1.** Fill in the table below for the parent function \( y = x^2 \) and graph the points.

<table>
<thead>
<tr>
<th>( x )</th>
<th>( y )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td></td>
</tr>
<tr>
<td>-2</td>
<td></td>
</tr>
<tr>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

Characteristics of a Quadratic Function

- **vertex:**
- **x-intercepts:**
- **y-intercepts:**
- **axis of symmetry (AOS):**
- **domain:**
- **maximum:**
- **range:**
- **minimum:**
Notes – Introduction to Quadratics

**EX2.** For the graph to the right, find the following:

a. vertex: ________________

b. aos: ________________

c. x-intercepts: ________________

d. y-intercepts: ________________

e. max. or min.: ________________

f. domain: ________________

g. range: ________________

You can use also your graphing calculator to graph a quadratic function and find the coordinates of its vertex.

**Follow these steps to find the vertex.**

- Enter the quadratic equation in y =
- You may have to change the viewing window to see a complete graph. Locate the vertex.

2nd Trace.

- If the parabola opens up (a > 0), the vertex is a minimum.

3: minimum

- If the parabola opens down (a < 0), the vertex is a maximum.

4: maximum

- Set the left bound: Move your cursor to the left side of where you think the vertex is by using the arrow keys. Then hit Enter.

- Set the Right bound: Move your cursor to the right side of where you think the vertex is by using the arrow keys. Then hit Enter.

- Guess: Move your cursor to the spot where you think it is. Then hit Enter.

**EX4.** Graph each function on your calculator. Tell whether there is a minimum or maximum. Then find the vertex, aos, domain and range.

a. \( y = (x + 2)(x - 3) \)  
   max/min: ________________  
   vertex: ________________  
   aos: ________________  
   domain: ________________  
   range: ________________

b. \( y = -0.5x^2 - 2x + 3 \)  
   max/min: ________________  
   vertex: ________________  
   aos: ________________  
   domain: ________________  
   range: ________________

Notes – Introduction to Quadratics

Sometimes you have to find the x-intercepts of the graph (which are also called the zeros or roots or solutions). We can also do that in the calculator!

**Follow these steps to find the zeros (roots).**

- Enter the quadratic equation in y =
- You may have to change the viewing window to see a complete graph. Locate the x-intercepts.

2nd Trace, then 2: Zero

- Left Bound: To find a zero or root scroll to the left of the point. Then hit Enter.

- Right Bound: Scroll to the right of the point. Then hit Enter.

- Guess: Scroll to where you think the graph crosses the x-axis. Then hit Enter.

- Record the first root.

- Repeat steps 1 thru 5 for the other root or zero.

**EX5.** Find the x-intercepts of the following equations using your calculator. Then draw a sketch of the graph.

a. \( y = x^2 - 5x - 24 \)  
   b. \( y = x^2 + 4x + 4 \)  
   c. \( y = -\frac{1}{4}x^2 - 10x + 20 \)

You can also look at the table to obtain the roots by finding a __________ in the _________ column.

**EX6.** Find the roots of each function from the table.

a. \[ \begin{array}{c|c} x & y_1 \\ \hline 0 & 6 \\ 1 & 3 \\ 2 & 0 \\ 3 & -3 \\ 4 & -6 \\ \end{array} \]

Roots: ________________

b. \[ \begin{array}{c|c} x & y_1 \\ \hline 0 & 0 \\ 1 & 1 \\ 2 & 2 \\ 3 & 2 \\ 4 & 0 \\ \end{array} \]

Roots: ________________
Attributes of Quadratic Functions

Identify the attributes of each quadratic function.

1. \( y = 2x^2 + 8x + 10 \)
   Max or Min: ________
   Vertex: ____________
   AOS: ______________
   Domain: ___________
   Range: ____________

2. \( y = -\frac{1}{2}x^2 - 2x + 3 \)
   Max or Min: ________
   Vertex: ____________
   AOS: ______________
   Domain: ___________
   Range: ____________

3. \( y = -(x - 2)(2x + 1) \)
   Max or Min: ________
   Vertex: ____________
   AOS: ______________
   Domain: ___________
   Range: ____________

4. \( y = 2(x - 5)^2 - 6 \)
   Max or Min: ________
   Vertex: ____________
   AOS: ______________
   Domain: ___________
   Range: ____________

5. \[
\begin{array}{c}
<table>
<thead>
<tr>
<th>x</th>
<th>y</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
<td>-9</td>
<td>-9</td>
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<td>9</td>
<td>9</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>
\end{array}
\]
   Max or Min: ________
   Vertex: ____________
   AOS: ______________
   Domain: ___________
   Range: ____________

6. \[
\begin{array}{c}
<table>
<thead>
<tr>
<th>x</th>
<th>y</th>
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</thead>
<tbody>
<tr>
<td>-10</td>
<td>-10</td>
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<td>9</td>
<td>9</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>
\end{array}
\]
   Max or Min: ________
   Vertex: ____________
   AOS: ______________
   Domain: ___________
   Range: ____________
7. The area of a rectangle is \( A = w^2 + 2w - 15 \) where \( A \) represents area and \( w \) represents width. What is the width?
   a. What are they asking you to find: Vertex or Roots
   b. Ordered pair(s): ______________________
   c. Answer: ______________________

8. A company’s daily profits are modeled by the equation \( P(x) = -x^2 + 50x + 200 \), where \( x \) is the number of items sold. What is the maximum profit the company can achieve per day, according to this mode?
   a. What are they asking you to find: Vertex or Roots
   b. Ordered pair(s): ______________________
   c. Answer: ______________________

9. A ball is thrown in the air and follows the path \( y = -x^2 - x + 20 \) where \( x \) represents the seconds and \( y \) represents the height. At what time will the ball hit the ground?
   a. What are they asking you to find: Vertex or Roots
   b. Ordered pair(s): ______________________
   c. Answer: ______________________

10. A business manager estimates that the cost of manufacturing \( x \) items each day is represented by \( C(x) = 0.5x^2 - 8x + 1500 \). How many items should the business manufacture each day in order to minimize its cost?
    a. What are they asking you to find: Vertex or Roots
    b. Ordered pair(s): ______________________
    c. Answer: ______________________

11. Graph the function \( f(x) = x^2 - 6x + 5 \). Identify the roots. Write the function in factored form. How do the roots relate to the factored form?
WARM-UP #_____

Use your calculator to graph each quadratic function. Label the axis of symmetry, vertex, and roots. State the domain and range.

1. \( y = x^2 - 6x + 5 \)

2. \( f(x) = (x - 3)^2 - 4 \)

3. \( y = (x - 1)(x - 5) \)
1. Complete the chart.

<table>
<thead>
<tr>
<th>Function</th>
<th>Sketch</th>
<th>Max or Min</th>
<th>Vertex</th>
<th>AOS</th>
<th>Roots</th>
<th>Domain</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y = 4x^2 + 8x - 12$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$f(x) = -3(x - 1)^2 + 4$</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$f(x) = (x - 9)(x + 2)$</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$f(x) = -2x^2 - 4x + 5$</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$y = 2(x - 4)(x - 6)$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$y = 3(x - 2)^2 - 4$</td>
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<td></td>
</tr>
</tbody>
</table>
2. A parabola forms the top of a fencing panel as shown. This parabola can be modeled by the graph of the function \( y = 0.03125x^2 - 0.25x + 4 \) where \( x \) and \( y \) are measured in feet and \( y \) represents the number of feet the parabola is above the ground. How far above the ground is the lowest point of the parabola formed by the fence?

3. The dome of the greenhouse shown can be modeled by the graph of the function \( f(x) = -0.15625x^2 + 2.5x \) where \( x \) and \( y \) are measured in feet.
   a. What is the height at the highest point of the dome as shown in the diagram?
   b. How wide is the dome along its base?

4. **Spiders** Fishing spiders can propel themselves across water and leap vertically from the surface of the water. During a vertical jump, the height of the body of the spider can be modeled by the function \( y = -4500x^2 + 820x + 43 \) where \( x \) is the duration (in seconds) of the jump and \( y \) is the height (in millimeters) of the spider above the surface of the water.
   a. After how many seconds does the spider’s body reach its maximum height?
   b. What is the maximum height?

Identify whether each quadratic function is written in vertex form or intercept form. Then convert each to standard form.

5. \( y = 4(x + 3)(x - 1) \)
6. \( f(x) = -3(x - 2)^2 - 4 \)
7. \( f(x) = 2(x + 1)^2 - 7 \)
1. An object is hurled upward from the ground at an initial velocity of 128 ft/s. The height \( h \) in feet of the object at any given time \( t \) in seconds is \( h(t) = 128t - 16t^2 \).
   
a. When will the object reach a height of 192 feet?
   
b. How long will the object be in the air?
   
c. When will the object reach its maximum height?
   
d. What is the maximum height of the object?
   
e. State the domain and range for the graph of the object’s path.

2. The function \( f(x) = 5x + 7 \) gives the amount of money Frank has in his pocket when he has \( x \) $5 bills and seven $1 bills. What is \( f(11) \)?

3. The Snowball Club is collecting box tops for a fundraiser. The table shows how many box tops they collected each week. Which is a true statement about this functional relationship?

<table>
<thead>
<tr>
<th>Week</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Box tops</td>
<td>60</td>
<td>75</td>
<td>90</td>
</tr>
</tbody>
</table>

   A. It is linear; the number of box tops increases by 15 each week.
   B. It is linear; the number of box tops decreases by 15 each week.
   C. It is not linear; the number of box tops is multiplied by 1.25 each week.
   D. It is not linear; the number of box tops is divided by 1.25 each week.
Transforming Quadratic Functions

Station 1:

Station 2:

Station 3:

Station 4:

Station 5:

Station 6:
Quadratic Transformations

Determine the transformations for each parabola. Then, use the transformations to write an equation in vertex form to represent each function.

1. 

2. 

Graph each function. Identify the axis of symmetry and three points on the parabola. State the domain and range.

3. \( y = -\frac{1}{4} (x - 4)^2 - 3 \)

   AOS: 
   3 points: (____,____), (____,____), (____,____)
   Transformations: ______________
   D: _______   R: _______

4. \( f(x) = (x + 3)^2 - 7 \)

   AOS: 
   3 points: (____,____), (____,____), (____,____)
   Transformations: ______________
   D: _______   R: _______
5. Which graph shows a function $y = x^2 + c$ when $c < -1$?

A. ![Graph A]

B. ![Graph B]

C. ![Graph C]

D. ![Graph D]

6. The graph of $y = 11x^2 + c$ is a parabola with a vertex at the origin. Which of the following is true about the value of $c$?

A. $c > 0$  

B. $c < 0$

C. $c = 0$  

D. $c = 11$

7. Shirley graphed a function of the form $y = ax^2 + c$. She then translated the graph 8 units up, resulting in the function $y = -\frac{2}{3}x^2 + 5$. Which of the following best represents Shirley's original function?

A. $y = -\frac{2}{3}x^2 + 13$  

B. $y = -\frac{2}{3}x^2 - 13$

C. $y = -\frac{2}{3}x^2 + 3$  

D. $y = -\frac{2}{3}x^2 - 3$

8. If $c = -5$, how does the graph of $y = x^2 + 2c$ compare to the graph of $y = x^2 + c$?

A. The graph of $y = x^2 + 2c$ is below the graph of $y = x^2 + c$.

B. The graph of $y = x^2 + 2c$ is above the graph of $y = x^2 + c$.

C. The graph of $y = x^2 + 2c$ is wider than the graph of $y = x^2 + c$.

D. The graph of $y = x^2 + 2c$ is narrower than the graph of $y = x^2 + c$. 
9. The graph of a function of the form $y = ax^2 + c$ is shown below.

If the graph is translated only up or down to include the ordered pair (6, 7), which of the following equations best represents the resulting graph?

A. $y = -\frac{1}{3}x^2 + 3$
B. $y = -\frac{1}{3}x^2 - 10$
C. $y = \frac{1}{3}x^2 + 1$
D. $y = \frac{1}{3}x^2 - 5$

10. The grid below shows parabolas A and B of the form $y = ax^2 + c$.

How are the parabolas A and B related?

A. Parabola A is narrower than parabola B.
B. Parabola A is wider than parabola B.
C. All the points on parabola A are 7 units below the corresponding points on parabola B.
D. All the points on parabola A are 7 units above the corresponding points on parabola B.
11. Given the functions $f(x)$ and $g(x)$ as described in the following tables.

<table>
<thead>
<tr>
<th>$x$</th>
<th>$y$</th>
<th>$x$</th>
<th>$y$</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1</td>
<td>5</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>0</td>
<td>2</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Describe the transformation from $f(x)$ to $g(x)$.

12. Given the functions $f(x)$ and $g(x)$ as described in the following tables.

<table>
<thead>
<tr>
<th>$x$</th>
<th>$y$</th>
<th>$x$</th>
<th>$y$</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2</td>
<td>5</td>
<td>-4</td>
<td>-4</td>
</tr>
<tr>
<td>-1</td>
<td>2</td>
<td>-3</td>
<td>-5</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>-2</td>
<td>-4</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>-1</td>
<td>-1</td>
</tr>
</tbody>
</table>

Describe the transformation from $f(x)$ to $g(x)$.

13. Describe two different transformations that would make the parabola pass through the point $(-2, -3)$.

14. What is the new equation of the function $y = 2(x - 5)^2 + 3$ if it now faces downward and is shifted 4 units to the left and 6 units down?
Graph each quadratic equation. Label the axis of symmetry and vertex. State the domain and range. If the equation is not in standard form, rewrite it so that it is in standard form.

1. \( y = 4x^2 + 8x + 1 \)

2. \( f(x) = -2(x - 3)^2 - 3 \)

3. \( y = (x - 1)(x - 5) \)
Notes – Solving Quadratic Equations by Factoring

EX1. Completely factor each polynomial.

a. \(3abx + 15cx^2y\)  
b. \(y^2 + 7y + 6\)

c. \(3a^2 + 24a + 45\)  
c. \(y^2 - 16\)

Steps to Solve by Factoring

1. 
2. 
3. 
4. 
5. 

EX2. Solve each equation by factoring.

a. \(x^2 + 10x + 25 = 0\)  
b. \(48t = 16t^2\)
Notes – Solving Quadratic Equations by Factoring

c. \( x^2 - x = 12 \)  
d. \( 4x^2 - 13x = 12 \)

e. \( y^2 = 121 \)  
f. \( 8x + 16 = 3x^2 \)
## Solving Quadratics by Factoring

<table>
<thead>
<tr>
<th>Quadratic Equation</th>
<th>Related Quadratic Function in Factored Form</th>
<th>x-intercepts/ zeros/roots/ solutions</th>
<th>Average of x-intercepts ((x + x)/2)</th>
<th>Axis of symmetry Equation: (x = )</th>
<th>Vertex of parabola ((x, y))</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. (x^2 + 2x - 8 = 0)</td>
<td>(y = (\quad)(\quad))</td>
<td>(x = ) (x = )</td>
<td>(x = ) (x = )</td>
<td>(x = )</td>
<td>((\quad, \quad))</td>
</tr>
<tr>
<td>2. (x^2 + x - 6 = 0)</td>
<td>(y = (\quad)(\quad))</td>
<td>(x = ) (x = )</td>
<td>(x = ) (x = )</td>
<td>(x = )</td>
<td>((\quad, \quad))</td>
</tr>
<tr>
<td>3. (x^2 + 2x - 15 = 0)</td>
<td>(y = (\quad)(\quad))</td>
<td>(x = ) (x = )</td>
<td>(x = ) (x = )</td>
<td>(x = )</td>
<td>((\quad, \quad))</td>
</tr>
<tr>
<td>4. (x^2 + 3x - 10 = 0)</td>
<td>(y = (\quad)(\quad))</td>
<td>(x = ) (x = )</td>
<td>(x = ) (x = )</td>
<td>(x = )</td>
<td>((\quad, \quad))</td>
</tr>
<tr>
<td>5. (x^2 + 10x + 16 = 0)</td>
<td>(y = (\quad)(\quad))</td>
<td>(x = ) (x = )</td>
<td>(x = ) (x = )</td>
<td>(x = )</td>
<td>((\quad, \quad))</td>
</tr>
<tr>
<td>6. (4x^2 - 12x + 9 = 0)</td>
<td>(y = (\quad)(\quad))</td>
<td>(x = ) (x = )</td>
<td>(x = ) (x = )</td>
<td>(x = )</td>
<td>((\quad, \quad))</td>
</tr>
<tr>
<td>7. (7x^2 + 35x - 42 = 0)</td>
<td>(y = (\quad)(\quad))</td>
<td>(x = ) (x = )</td>
<td>(x = ) (x = )</td>
<td>(x = )</td>
<td>((\quad, \quad))</td>
</tr>
<tr>
<td>8. (3x^2 - 8x - 16 = 0)</td>
<td>(y = (\quad)(\quad))</td>
<td>(x = ) (x = )</td>
<td>(x = ) (x = )</td>
<td>(x = )</td>
<td>((\quad, \quad))</td>
</tr>
<tr>
<td>9. (5x^2 + 4x - 1 = 0)</td>
<td>(y = (\quad)(\quad))</td>
<td>(x = ) (x = )</td>
<td>(x = ) (x = )</td>
<td>(x = )</td>
<td>((\quad, \quad))</td>
</tr>
<tr>
<td>10. (2x^2 + 9x + 10 = 0)</td>
<td>(y = (\quad)(\quad))</td>
<td>(x = ) (x = )</td>
<td>(x = ) (x = )</td>
<td>(x = )</td>
<td>((\quad, \quad))</td>
</tr>
</tbody>
</table>
11. Use factoring to determine the x-intercepts of the graph of the function $y = x^2 + 2x - 15$.

12. Which could be the function graphed here?

A. $f(x) = -\frac{1}{2}(x - 2)(x + 6)$
B. $f(x) = -\frac{1}{2}(x + 2)(x - 6)$
C. $f(x) = -(x - 2)(x - 8)$
D. $f(x) = -(x + 1)(x - 3)$

13. Determine the solutions for the quadratic equation $x(2x + 1) = 10$.

14. The area of a rectangle is 70 square meters. The length is 4 meters less than twice the width. What is the length?

A. 6 meters
B. 7 meters
C. 10 meters
D. 12 meters

15. The graph shows the height of a football from the time it is kicked until it hits the ground. For how long is the football at least 20 feet above the ground?

A. About 3.5 seconds
B. About 2.5 seconds
C. About 1.5 seconds
D. About 0.75 seconds
1. Solve by factoring.\[3x^2 = 5x + 2\]

2. Identify the following attributes for the quadratic function shown.
   a. max. or min.: ______________
   b. vertex: ______________
   c. aos: __________
   d. x-intercepts: ______________
   e. y-intercepts: ______________
   f. domain: ______________
   g. range: ______________

3. What is the new equation of the function \(y = 2(x - 5)^2 + 3\) if it now faces downward and is shifted 4 units to the left and 6 units down?

4. The equation of a parabola is \(y = x^2 + 6x + 3\). Which of the following represents the equation in the form \(y = a(x - h)^2 + k\)?

   A. \(y = (x + 3)^3 + 6\)  
   B. \(y = (x + 3)^2 - 6\)  
   C. \(y = (x - 3)^2 - 6\)  
   D. \(y = (x + 3)^2 + 12\)
Explain – Simplifying Radicals

**EX1.** Use your device to answer the following questions.

a. What is another word for radical sign in math?

b. What is a radicand?

c. Write an expression and label the radical and radicand.

*In order for a radical to be simplified, it must not have any perfect square factors in the radicand.*

**EX2.** Use a factor tree (prime factorization) to break down the numbers below. Then circle pairs of prime factors.

a. 147  
b. 52  
c. 360

**To simplify a radical:**

1. 

2. 

3. 

**EX3.** Simplify each square root.

a. $\sqrt{147}$  
b. $\sqrt{52}$  
c. $\sqrt{360}$

d. $\sqrt{525a^2b^3}$  
e. $\sqrt{90x^7y^{10}}$
**EX4.** Simplify each of the following.

a. \(3\sqrt{7} - 4\sqrt{7} + 2\sqrt{7}\)  
b. \(5\sqrt{3} - 4\sqrt{7} - 3\sqrt{3} + \sqrt{7}\)

c. \(5\sqrt{x} - 3\sqrt{x} + \sqrt{x}\)  
d. \(\frac{6 + 4\sqrt{3}}{2}\)

e. \(\frac{14 - 6\sqrt{2}}{4}\)  
f. \(\frac{10 + \sqrt{48}}{2}\)

**EX5.** Arrange each equation in standard form, \(ax^2 + bx + c\). Identify \(a\), \(b\), and \(c\), and calculate \(\sqrt{b^2 - 4ac}\) in simplest form.

a. \(7x^2 - 2x - 5 = 0\)  
b. \(3x^2 + 12x - 12 = 0\)

\[a = \ldots\]  
\[b = \ldots\]  
\[c = \ldots\]

\[a = \ldots\]  
\[b = \ldots\]  
\[c = \ldots\]

c. \(3x^2 - 5x^2 + 1 = 6 - 7x\)

\[a = \ldots\]  
\[b = \ldots\]  
\[c = \ldots\]
Simplifying Radicals

Simplify each expression. Leave answers in exact form.

1. \(4\sqrt{5} + \sqrt{245}\)

2. \(-\sqrt{189}\)

3. \(\sqrt{112} + \sqrt{63}\)

4. \(\sqrt{a^4b^3cd^6}\)

5. \(\frac{12 - 3\sqrt{6}}{15}\)

6. \(\frac{10 + 15\sqrt{3}}{5}\)

Find \(\sqrt{b^2 - 4ac}\). Leave answers in exact form.

7. \(7x^2 - 4x + 5 = 0\)

8. \(4x^2 - 9x + 2 = 0\)

9. \(-3x^2 + 6x - 3 = 0\)

10. \(3x^2 = -3x + 1\)

11. \(8x - 4 = 2x^2\)

12. \(8x^2 + 10x - 1 = 4x\)

13. What is the approximate perimeter of a square with an area of 30 square meters?

   A. 5.5 m
   B. 11 m
   C. 22 m
   D. 30 m
Review

14. The graph shows the arched entrance to an arboretum. About how wide is the arch at a point 5 feet above the ground?

A. 1.2 feet  
B. 5.6 feet  
C. 6.8 feet  
D. 8 feet

15. What is the maximum height of the archway?

16. Donna is solving \( x^2 - 2x - 8 = 0 \). She drew the graph of \( f(x) = x^2 - 2x - 8 \) as shown below.

   a. What are the solutions of the equation \( x^2 - 2x - 8 = 0 \)?

   b. Rewrite the function in intercept form.

17. Which function has a zero between 7 and 8?

   A. \( f(x) = \frac{1}{2}x^2 + 5x + 12 \)  
   B. \( f(x) = -4x^2 + 6x + 5 \)  
   C. \( f(x) = 3x^2 - 24x + 12 \)  
   D. \( f(x) = \frac{1}{2}x^2 + 12 \)

18. Solve each of the following quadratic equations by factoring.

   a. \( 3x^2 = 5x + 2 \)  
   b. \( x^2 = 4x + 12 \)  
   c. \( x^2 + 14x + 49 = 0 \)
WARM-UP #_______

Simplify each of the following. Then, approximate any irrational roots to the nearest hundredth.

1. \( \frac{-3 \pm \sqrt{25}}{8} \)

2. \( \frac{-2 \pm \sqrt{40}}{6} \)

3. \( \frac{-6 \pm \sqrt{24}}{2} \)

4. \( \frac{5 \pm \sqrt{17}}{2} \)
Solving Quadratic Equations by Using the Quadratic Formula

Standard form of a quadratic equation: ________________

Quadratic Formula

The solutions of a quadratic equation in the form $ax^2 + bx + c = 0$, where $a \neq 0$, are given by the formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

The quadratic formula can be used to solve any quadratic equation involving any variable.

- Discriminant:

<table>
<thead>
<tr>
<th>Value of discriminant</th>
<th>$b^2 - 4ac &gt; 0$</th>
<th>$b^2 - 4ac = 0$</th>
<th>$b^2 - 4ac &lt; 0$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number and type of solutions</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Example graph

**EX1.** Solve each equation by using the quadratic formula. Approximate irrational roots to the nearest hundredth.

a. $x^2 - 2x - 24 = 0$

$$x = \frac{-(-2) \pm \sqrt{(-2)^2 - 4(1)(____)}}{2(1)}$$

a = ________

b = ________

c = ________
EX1 (cont). Solve each equation by using the quadratic formula. Approximate irrational roots to the nearest hundredth.

b. \(x^2 + 10x + 12 = 0\)
   
   \[a = __________\]
   \[b = __________\]
   \[c = __________\]

c. \(5y^2 = y + 4\)
   
   \[a = __________\]
   \[b = __________\]
   \[c = __________\]

d. \(r^2 + 25 = 0\)
   
   \[a = __________\]
   \[b = __________\]
   \[c = __________\]

e. \(24x^2 - 14x = 6\)
   
   \[a = __________\]
   \[b = __________\]
   \[c = __________\]
Using the Quadratic Formula

Solve the equations using the quadratic formula.

1. \( x^2 + 8x + 15 = 0 \)
2. \( -4x - 3 = -2x^2 \)

3. \( 4x^2 - x - 5 = 0 \)
4. \( 7x - 12 = x^2 \)

5. \( x^2 - 4x - 21 = 0 \)
6. \( 3x^2 + 1 = -5x \)

7. \( 2x^2 + 5x = 42 \)
8. \( x^2 - 6x = 10 \)
Using the Quadratic Formula

Describe and correct the error in solving each equation.

9. \(7x^2 - 5x - 1 = 0\)
\[
\begin{array}{c}
\begin{align*}
x &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\
&= \frac{5 \pm \sqrt{(-5)^2 - 4(7)(-1)}}{2(7)} \\
&= \frac{5 \pm \sqrt{25 + 28}}{14} \\
&= \frac{5 \pm \sqrt{53}}{14} \\
x &= -0.88 \quad \text{and} \quad x = 0.16
\end{align*}
\end{array}
\]

10. \(-2x^2 + 3x = 1\)
\[
\begin{array}{c}
\begin{align*}
x &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\
&= \frac{3 \pm \sqrt{3^2 - 4(-2)(1)}}{2(-2)} \\
&= \frac{3 \pm \sqrt{9 + 8}}{-4} \\
&= \frac{3 \pm \sqrt{17}}{-4} \\
x &= -0.28 \quad \text{and} \quad x = 1.78
\end{align*}
\end{array}
\]

11. For the period 1971-2001, the number of films produced in the world can be modeled by the function \(y = 10x^2 - 94x + 3900\) where \(x\) is the number of years since 1971. Determine the year 4200 films were produced?

12. Which best describes the graph of a quadratic function with a discriminant of -3?
   A. Parabola with two x-intercepts
   B. Parabola with no x-intercepts
   C. Parabola that opens upward
   D. Parabola that opens downward

13. Which best describes the discriminant of the function whose graph is shown?
   A. Positive
   B. Zero
   C. Negative
   D. Undefined
1. Analyze Quadratic Function

The rocket was launched from a height of _______ meters. It reached a maximum height of _______ meters after _______ seconds. The rocket was in the air for just under _______ seconds. The rocket was above 35 meters for about _______ seconds.

Domain = {______ ≤ time ≤ _______}

Range = {______ ≤ height ≤ _______}

2. Quadratic Formula

\[ x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \]

a =  

b =  

c =  

3. Application (Area of rectangle)

4. Transformations

a. Describe how the parabola graphed has been transformed from its parent function. Use your description to write the equation of the quadratic function graphed.

b. Write the equation of a quadratic function that is narrower than the one graphed and opens down.

c. Use your equation from part b to write the equation of a new quadratic function that has been shifted up 3 units.
<table>
<thead>
<tr>
<th>5. Characteristics</th>
<th>6. Solving by Factoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>( f(x) = )</td>
<td>a.</td>
</tr>
<tr>
<td>vertex: ___________</td>
<td></td>
</tr>
<tr>
<td>aos: _____________</td>
<td></td>
</tr>
<tr>
<td>roots: ___________</td>
<td>b.</td>
</tr>
<tr>
<td>( f(x) = 200 )</td>
<td></td>
</tr>
<tr>
<td>when ( x = )</td>
<td></td>
</tr>
<tr>
<td>or ___________</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>7. Solutions from Graphs and Tables</th>
<th>8. Application (Vertical Motion)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>( s = )</td>
</tr>
<tr>
<td></td>
<td>Find the time it takes for the baseball to strike ground.</td>
</tr>
<tr>
<td>b.</td>
<td>How high will the ball be in 6 seconds?</td>
</tr>
<tr>
<td>c.</td>
<td>When will the ball be 448 feet in the air?</td>
</tr>
<tr>
<td>d.</td>
<td>If the ball fell into a sinkhole that was 192 feet deep, how long did it take to hit the bottom of the sinkhole?</td>
</tr>
</tbody>
</table>
## Review – Quadratics

Fill in the chart.

<table>
<thead>
<tr>
<th>Equation</th>
<th>Opens up Or Down</th>
<th>Vertex</th>
<th>Axis of Symmetry</th>
<th>Domain</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ( y = \frac{1}{2}x^2 )</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. ( y = -8x^2 )</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. ( y = -4.9x^2 + 8 )</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. ( y + 5 = -2x^2 + 3x )</td>
<td></td>
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</tr>
<tr>
<td>5. ( 3y = 9x^2 - 6 - 18x )</td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. John is trying out for the football team. He really wants to be the punter. The coach says that he is going to select the punter who is able to kick the ball into the end-zone from any place on the field. Which of the following equations would represent the parabola created by this kick? Explain your reasons for either selecting or not selecting each option.

A. \( y = \frac{1}{10}x^2 - 5 \)  
B. \( y = -\frac{1}{10}x^2 - 5 \)  
C. \( y = 10x^2 - 5 \)  
D. \( y = -10x^2 + 5 \)

7. Solve the quadratic by factoring: \( x^2 + 3x - 10 = 0 \)
8. The vertex of a parabola is (3, -2), and one of the x-intercepts is (-2, 0). Find the other x-intercept.

9. The vertex of the parabola is (-3, 5) and the y-intercept of the parabola is (0, -4).
   a. Give the point of reflection across the axis of symmetry.
   b. Is the vertex a maximum or a minimum?

10. The vertex of a parabola is (7, 12). Give the axis of symmetry.

11. Given the equation \( y = 5x^2 - 8 \), write an equation of a parabola if the graph has been shifted up 6.

12. Given the equation \( y = \frac{-2}{5}x^2 + 1 \), write an equation of a parabola if the graph has been shifted down 7.

13. A rectangle has a length of \( 4x + 9 \) and a width of \( x + 3 \). Which expression describes the area of the rectangle?
   A. \( 10x + 24 \)
   B. \( 5x + 12 \)
   C. \( 4x^2 + 21x + 27 \)
   D. \( 4x^2 + 27 \)

14. The length of a rectangular field is 5 meters longer than its width. The area of the field is 176 square meters. Which equation will determine the dimensions of the field?
   A. \( x^2 + 5x + 176 = 0 \)  
   B. \( 4x + 10 = 176 \)
   C. \( x^2 + 5 = 176 \)
   D. \( 2x + 5 = 176 \)
   E. \( x(x + 5) = 176 \)
For numbers 15-16, complete the following tables and graph the parabolas. Your table must include the vertex and 4 other points. You should use symmetry to complete the graph. Give the equation of the axis of symmetry and the y-intercept.

15. \( y = x^2 + 4 \)

<table>
<thead>
<tr>
<th>x</th>
<th>y</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
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<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Vertex__________
y-intercept_______
axis of symmetry____
roots ______________

16. \( y = -x^2 - 4x + 5 \)

<table>
<thead>
<tr>
<th>x</th>
<th>y</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Vertex__________
y-intercept_______
axis of symmetry____
roots ______________

17. The parabola \( y = x^2 \) is changed to \( y = \frac{1}{3}x^2 \).
   a. Name two things that have changed.

   ________________________

   b. Name three things that have remained the same.

   ________________________

18. The length of a rectangle is 12 more than the width. The area is 325. Which equation best represents the situation if \( w \) represents the width of the rectangle?

   A. \( w^2 - 325w + 12 = 0 \)  B. \( w^2 - 12w - 325 = 0 \)
   C. \( w^2 + 12w - 325 = 0 \)  D. \( w^2 + 12w + 325 = 0 \)
19. Find the roots using your calculator. \( y = 4x^2 - 13x + 10 \)

20. Use the quadratic formula to solve each quadratic equation. Leave answer in simplest form.
   a. \( 4x^2 + 7x = 15 \)
   b. \( 5w^2 + 4 = w + 6 \)
   c. \( 6r^2 = 2r^2 + 7r + 5 \)
   d. \( 4t^2 + 20t + 25 = 0 \)

21. Nathan is throwing tennis balls that were hit out of the court back to the players. The graph represents the height of each tennis ball versus time. Use the graph to fill in each blank.
   a. Between 0.5 seconds and 0.75 seconds, the tennis ball descended ____ foot.
   b. The tennis ball reaches its maximum height of _______ feet _______ seconds after being thrown.
   c. The tennis ball was above 4 feet for about _______ second.
   d. Between _______ second and _______ second, the tennis ball is seven feet above the ground.