1. Consider the following data.

<table>
<thead>
<tr>
<th>x</th>
<th>-4</th>
<th>-3</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>14</td>
<td>7</td>
<td>2</td>
<td>-1</td>
<td>-2</td>
<td>-1</td>
<td>2</td>
<td>7</td>
<td>14</td>
</tr>
</tbody>
</table>

a) Create a scatter plot, and draw a curve.

b) Use your graph to determine the value of $x$ when $y = 2.5$.

2. Expand and simplify each expression.

a) $4(5x - 3)$

b) $-2(4 - 3x) + 4(2x - 5)$

c) $a^2(2a + 6b - 7) + a(2a^2 - 6ab + a)$

3. Determine the value of $y$ for each given value of $x$.

a) $y = 18 - 2x$, when $x = 4.5$

b) $y = x^2 - x - 6$, when $x = -2$

4. Camille works as a computer administrator. She earns a base salary of $500/week plus $25 for every computer she fixes. Make a table of values, construct a graph, and write an equation to represent Camille’s weekly earnings.

5. Determine the $x$- and $y$-intercepts for each relation. Then sketch the graph.

a) $2x - 5y = 10$

b) $x - y - 9 = 0$

c) $x = 5$
Chapter 3 Diagnostic Test Answers

1. a) 

b) \( x \approx 2.1 \)

2. a) 20x – 12 

b) 14x – 28 

c) 4a³ – 6a²

3. a) 9 

b) 0

4. 

<table>
<thead>
<tr>
<th>x</th>
<th>y</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>500</td>
</tr>
<tr>
<td>1</td>
<td>525</td>
</tr>
<tr>
<td>2</td>
<td>550</td>
</tr>
<tr>
<td>3</td>
<td>575</td>
</tr>
</tbody>
</table>

5. a) \( x = 5, y = -2 \) 

b) \( x = 9, y = -9 \) 

c) \( x = 5, \) no \( y \)-intercept

If students have difficulty with the questions in the Diagnostic Test, it may be necessary to review the following topics:

- graphing a linear relation
- solving a linear equation
- multiplying a polynomial by a monomial
Lesson 3.2 Extra Practice

1. For each parabola, determine
   i) the equation of the axis of symmetry
   ii) the coordinates of the vertex
   iii) the y-intercept
   iv) the zeros
   v) the maximum or minimum value

   a) ![Graph a]
   b) ![Graph b]
   c) ![Graph c]
   d) ![Graph d]
   e) ![Graph e]

2. Sketch the graph of each quadratic relation below. Then determine
   i) the equation of the axis of symmetry
   ii) the coordinates of the vertex
   iii) the y-intercept
   iv) the zeros
   v) the maximum or minimum value

   a) \( y = x^2 - 9 \)  
   b) \( y = x^2 - 4x + 4 \)  
   c) \( y = -x^2 - 2 \)  
   d) \( y = -x^2 - 4x \)

3. Two points, on opposite sides of the same parabola, are given. Determine the equation of the axis of symmetry of the parabola.

   a) \((-1, -5), (-5, -5)\)
   b) \((6.5, -4), (9.0, -4)\)
   c) \((-6, 3), (5, 3)\)
   d) \((-6 \frac{1}{2}, -7), (-1 \frac{1}{2}, -7)\)

4. Kim knows that \((-2, 31)\) and \((8, 31)\) lie on a parabola defined by the equation \(y = 3x^2 - 18x - 17\). What are the coordinates of the vertex?

5. A golf ball is hit from the ground. Its height above the ground, in metres, can be approximated by the relation \(h = 24t - 4t^2\), where \(t\) is the time in seconds.

   a) What are the zeros of this relation?
   b) When does the ball hit the ground?
   c) What are the coordinates of the vertex?
   d) Use the information from parts a) and c) to draw the graph.
   e) What is the maximum height of the golf ball? After how many seconds does the maximum height occur?
Lesson 3.2 Extra Practice Answers

1. a) i) $x = 3$
   
   ii) $(3, 4)$
   
   iii) $-5$
   
   iv) $1, 5$
   
   v) $4$ (maximum)
   
   b) i) $x = 0$
   
   ii) $(0, -4)$
   
   iii) $-4$
   
   iv) $-2, 2$
   
   v) $-4$ (minimum)
   
   c) i) $x = -3$
   
   ii) $(-3, 5)$
   
   iii) $0$
   
   iv) $0, -6$
   
   v) $5$ (maximum)
   
   d) i) $x = -4$
   
   ii) $(-4, -4)$
   
   iii) $12$
   
   iv) $-2, -6$
   
   v) $-4$ (minimum)
   
   e) i) $x = 2$
   
   ii) $(2, 6)$
   
   iii) $10$
   
   iv) none
   
   v) $6$ (minimum)
   
   f) i) $x = -2$
   
   ii) $(-2, 0)$
   
   iii) $-5$
   
   iv) $-2$
   
   v) $0$ (maximum)

c) $y = -x^2 - 2$
   
   i) $x = 0$
   
   ii) $(0, 10)$
   
   iii) $10$
   
   iv) $10$
   
   v) $10$ (maximum)

d) $y = x^2 - 4x$
   
   i) $x = 2$
   
   ii) $(2, 0)$
   
   iii) $4$
   
   iv) $2$
   
   v) $0$ (minimum)

2. a)

   i) $x = 0$
   
   ii) $(0, -9)$
   
   iii) $-9$
   
   iv) $-3, 3$
   
   v) $-9$ (minimum)

b)

   i) $x = 2$
   
   ii) $(2, 0)$
   
   iii) $4$
   
   iv) $2$
   
   v) $0$ (minimum)

3. a) $x = -3$
   
   b) $x = 7.75$
   
   c) $x = -0.5$
   
   d) $x = -4$

4. (3, -44)

5. a) 0, 6
   
   b) 6 s
   
   c) (3, 36)
   
   d) 36 m; 3 s
Lesson 3.3 Extra Practice

1. For each quadratic relation below, determine
   i) the zeros
   ii) the y-intercept
   iii) the equation of the axis of symmetry
   iv) the coordinates of the vertex
   a) \( y = -3x(x + 4) \)  
   b) \( y = -(6 + x)(x - 2) \)  
   c) \( y = (x - 7)(x + 5) \)  
   d) \( y = -2(x - 4)(x + 6) \)

2. Sketch each quadratic relation in question 1.

3. A parabola has an equation of the form
   \( y = a(x - r)(x - s) \). Determine the value of \( a \) when
   a) the parabola has zeros at \((-3, 0)\) and \((7, 0)\) and a y-intercept at \((0, 7)\)
   b) the parabola has zeros at \((4, 0)\) and \((2, 0)\) and a maximum value of 6
   c) the parabola has an x-intercept at \((-9, 0)\) and its vertex at \((-4, 75)\)

4. Determine the y-intercept, zeros, equation of the axis of symmetry, and vertex of each parabola. Determine an equation for the parabola.
   a) 
   b) 

5. The x-intercepts of a parabola are 1 and 7, and the parabola passes through the point \((3, 4)\).
   a) Determine an equation for the parabola.
   b) Determine the coordinates of the vertex.

6. Andrew threw a football. This graph shows the height of the football at different times during its flight.

   a) After how many seconds did the football reach its maximum height?
   b) After how many seconds did the football hit the ground?
   c) Determine an equation for the graph.
Lesson 3.3 Extra Practice Answers

1. a) i) 0, –4  ii) 0  iii) \( x = -2 \)  iv) \((-2, 12)\)
   b) i) –6, 2  ii) 12  iii) \( x = -2 \)  iv) \((-2, 16)\)
   c) i) –5, 7  ii) –35  iii) \( x = 1 \)  iv) \((1, -36)\)
   d) i) –6, 4  ii) 48  iii) \( x = -1 \)  iv) \((-1, 50)\)

2. a) \[
   y = -3x + 4
   \]
   b) \[
   y = -(x + 6)(x - 2)
   \]
   c) \[
   y = -(x - 7)(x + 5)
   \]
   d) \[
   y = -2(x - 4)(x + 6)
   \]

3. a) \( \frac{-1}{3} \)
   b) \(-6\)
   c) \(-3\)

4. a) \( y \)-intercept: 50; zeros: \(-10, 10\); equation of the axis of symmetry: \( x = 0 \); vertex: \((0, 50)\);
   equation: \( y = -\frac{1}{2}(x - 10)(x + 10) \)
   b) \( y \)-intercept: 60; zeros: 20, 60; equation of the axis of symmetry: \( x = 40 \); vertex: \((40, -20)\);
   equation: \( y = \frac{1}{20}(x - 20)(x - 60) \)
   c) \( y \)-intercept: 3; zeros: \(-1, 3\); equation of the axis of symmetry: \( x = 1 \); vertex: \((1, 4)\);
   equation: \( y = -(x - 3)(x + 1) \)
   d) \( y \)-intercept: 32; zeros: 4, 8; equation of the axis of symmetry: \( x = 6 \); vertex: \((6, -4)\);
   equation: \( y = (x - 4)(x - 8) \)

5. a) \( \frac{1}{2}(x - 1)(x - 7) \)
   b) \((4, 4.5)\)

6. a) after 3 s
   b) after 6 s
   c) \( y = -2x(x - 6) \)
Chapter 3 Mid-Chapter Review Extra Practice

STUDENT BOOK PAGES 159–160

1. Determine whether each relation is quadratic. Justify your answer.
   a) \[\begin{array}{c|c|c|c|c|c}
   x & -2 & -1 & 0 & 1 & 2 \\
   y & 11 & 3 & 3 & 11 & 27 \\
   \end{array}\]
   b) \(y = 5x^2 - x^3\)
   c) \(y = 4x - 3x^2 + 1\)
   d) \(y = 5x^2 - x^3\)

2. Examine each parabola.
   i) Determine the coordinates of the vertex.
   ii) Determine the zeros.
   iii) Determine the equation of the axis of symmetry.
   iv) If you calculated the second differences, would they be positive or negative? Explain.

3. For each quadratic relation below, determine
   i) the equation of the axis of symmetry
   ii) the coordinates of the vertex
   iii) the \(y\)-intercept
   iv) the zeros
   v) the maximum or minimum value
   Then sketch a graph of the relation.
   a) \(y = -x(x + 6)\)  \(\quad\) b) \(y = x^2 - 2x - 3\)

4. Two points, on opposite sides of the same parabola, are given. Determine the equation of the axis of symmetry of the parabola.
   a) \((-1, 4), (15, 4)\)
   b) \((2.5, -3.5), (8.5, -3.5)\)
   c) \((-12, 12), (-3, 12)\)

5. A ball is thrown from the top of a building. Its height above the ground can be approximated by the relation \(h = 8 + 6t - 2t^2\), where \(h\) is the height in metres and \(t\) is the time in seconds.
   a) From what height is the ball thrown?
   b) How long is the ball in the air?
   c) What is the maximum height of the ball?
   d) When does the ball reach a height of 10 m?

6. Determine the \(y\)-intercept, zeros, equation of the axis of symmetry, and vertex of each quadratic relation. Then sketch a graph of the relation.
   a) \(y = (x + 3)(x - 5)\)  \(\quad\) c) \(y = -(x + 4)(x - 2)\)
   b) \(y = -2(x + 3)^2\)  \(\quad\) d) \(y = 3(x - 1)(x + 3)\)

7. The \(x\)-intercepts of a parabola are 2 and \(-12\). The parabola crosses the \(y\)-axis at \(-108\).
   a) Determine an equation for the parabola.
   b) Determine the coordinates of the vertex.

8. Determine an equation for this quadratic relation.
Chapter 3 Mid-Chapter Review Extra Practice Answers

1. a) yes; all the second differences are 8, so they are constant and non-zero
   b) no; degree 3
c) yes; degree 2
d) yes; parabola

2. a) i) (3, 4) ii) 1, 5 iii) x = 3
   iv) negative, because the parabola opens downward
   b) i) (2, –4) ii) 0, 4 iii) x = 2
   iv) positive, because the parabola opens upward

3. a) i) x = –3
   ii) (–3, 9)
   iii) 0
   iv) –6, 0
   v) 9 (maximum)
b) i) x = 1
   ii) (1, –4)
   iii) –3
   iv) –1, 3
   v) –4 (minimum)

4. a) x = 7
   b) x = 5.5
c) x = –7.5

5. a) about 8 m
   b) about 4 s
c) about 12.5 m
d) about 0.4 s, about 2.6 s

6. a) y-intercept: –15; zeros: –3, 5; equation of the axis of symmetry: x = 1; vertex: (1, –16)

   b) y-intercept: –18; zero: –3; equation of the axis of symmetry: x = –3; vertex: (–3, 0)

   c) y-intercept: 8; zeros: –4, 2; equation of the axis of symmetry: x = –1; vertex: (–1, 9)

   d) y-intercept: –9; zeros: –3, 1; equation of the axis of symmetry: x = –1; vertex: (–1, –12)

7. a) \(y = 4.5(x – 2)(x + 12)\)
b) (–5, –220.5)

8. \(y = –(x – 1)(x – 7)\)
Lesson 3.4 Extra Practice

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1. Expand and simplify each expression.
   a) \((x + 3)(x + 4)\)
   b) \((x - 5)(x - 3)\)
   c) \((x + 5)(x + 5)\)
   d) \((x + 4)(x - 2)\)
   e) \((x - 2)(x - 2)\)
   f) \((x - 6)(x + 3)\)

2. Expand and simplify.
   a) \((2x + 3)(x + 1)\)
   b) \((3x - 1)(2x - 1)\)
   c) \((8x - 3)(6x - 7)\)
   d) \((x - 2)(3x + 1)\)
   e) \((2x - 5)(x + 1)\)
   f) \((4x - 3)(7x + 6)\)

3. Expand and simplify.
   a) \((x + 5)(x - 5)\)
   b) \((5x - 2)(5x + 2)\)
   c) \((2x - 1)^2\)
   d) \((x - 4)(x + 4)\)
   e) \((x + 3)^2\)
   f) \((-4x + 3)^2\)

4. Write a simplified expression for the area of each figure.
   a) \(2m + 1\)
   b) \(2x + 3\)
      \(5x - 1\)

5. Expand and simplify each expression.
   a) \(3(x - 4)(x + 7)\)
   b) \(-(x + 5)(2x - 1)\)
   c) \(-3(1 - 2x)(1 + 2x)\)
   d) \(2(3x + 7)^2\)
   e) \((x - 2)(4x + 3) - (x + 3)^2\)
   f) \(3(2x + 1)^2 - 2(x - 5)^2\)

6. Determine an equation for each parabola. Express the equation in standard form.
   a) \(y = ax^2 + bx + c\)
   b) \(y = a(x - h)^2 + k\)
   c) \(y = a(x - h)^2 + k\)

7. The dimensions of a rectangle are \((2x + 3)\) and \((3x - 4)\). Kendra determined the expression \(6x^2 - 17x - 12\) to represent the area. Is Kendra’s expression correct? Justify your answer.
Lesson 3.4 Extra Practice Answers

1. a) \(x^2 + 7x + 12\)
   b) \(x^2 - 8x + 15\)
   c) \(x^2 + 10x + 25\)
   d) \(x^2 + 2x - 8\)
   e) \(x^2 - 4x + 4\)
   f) \(x^2 - 3x - 18\)

2. a) \(2x^2 + 5x + 3\)
   b) \(6x^2 - 5x + 1\)
   c) \(48x^2 - 74x + 21\)
   d) \(3x^2 - 5x - 2\)
   e) \(2x^2 - 3x - 5\)
   f) \(28x^2 + 3x - 18\)

3. a) \(x^2 - 25\)
   b) \(25x^2 - 4\)
   c) \(4x^2 - 4x + 1\)
   d) \(x^2 - 16\)
   e) \(x^2 + 6x + 9\)
   f) \(16x^2 - 24x + 9\)

4. a) \(6m^2 + m - 1\)
   b) \(10x^2 + 13x - 3\)

5. a) \(3x^2 + 9x - 84\)
   b) \(-2x^2 - 9x + 5\)
   c) \(-3 + 12x^2\)
   d) \(18x^2 + 84x + 98\)
   e) \(3x^2 - 11x - 15\)
   f) \(10x^2 + 32x - 47\)

6. a) \(y = -x^2 + 4x\)
   b) \(y = x^2 + 6x + 5\)
   c) \(y = -2x^2 + 16x - 24\)

7. No, Kendra’s expression is not correct. The mistake is in the middle term. It should be \(x\). When the expression for the area is expanded, the coefficients of the \(x\) terms are –8 and 9, and their sum is 1, not –17 as in Kendra’s expression. The correct expression is \(6x^2 + x - 12\).
Lesson 3.5 Extra Practice

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1. A parabola passes through the points (–2, 14), (–1, 0), (0, –10), (1, –16), (2, –18), (3, –16), (4, –10), and (5, 0). Determine an equation for the parabola in factored form.

2. Kathy kicked a soccer ball straight up into the air. The height of the ball was recorded every 0.25 s, as given in the table below.

<table>
<thead>
<tr>
<th>Time (s)</th>
<th>Height (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>0.0</td>
</tr>
<tr>
<td>0.25</td>
<td>3.0</td>
</tr>
<tr>
<td>0.50</td>
<td>4.8</td>
</tr>
<tr>
<td>0.75</td>
<td>5.8</td>
</tr>
<tr>
<td>1.00</td>
<td>6.2</td>
</tr>
<tr>
<td>1.25</td>
<td>5.7</td>
</tr>
<tr>
<td>1.50</td>
<td>4.6</td>
</tr>
<tr>
<td>1.75</td>
<td>2.7</td>
</tr>
<tr>
<td>2.00</td>
<td>0.0</td>
</tr>
</tbody>
</table>

a) Use the data in the table to create a scatter plot. Then draw a curve of good fit.
b) Determine an equation for the curve of good fit you drew.

3. Jamie and Grace are conducting an experiment on motion. They set up a motion detector to collect data for Jamie on his skateboard as he moved toward the motion detector. The time and distance recorded by the motion detector are given in the table below.

<table>
<thead>
<tr>
<th>Time (s)</th>
<th>Distance (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>15.1</td>
</tr>
<tr>
<td>0.5</td>
<td>15.0</td>
</tr>
<tr>
<td>1.0</td>
<td>14.6</td>
</tr>
<tr>
<td>1.5</td>
<td>14.0</td>
</tr>
<tr>
<td>2.0</td>
<td>13.1</td>
</tr>
<tr>
<td>2.5</td>
<td>12.0</td>
</tr>
<tr>
<td>3.0</td>
<td>10.6</td>
</tr>
<tr>
<td>3.5</td>
<td>9.0</td>
</tr>
<tr>
<td>4.0</td>
<td>7.1</td>
</tr>
<tr>
<td>4.5</td>
<td>5.0</td>
</tr>
<tr>
<td>5.0</td>
<td>2.0</td>
</tr>
</tbody>
</table>

a) Create a scatter plot, and draw a curve of good fit.
b) Determine an equation for your curve of good fit.
c) Use your equation to predict the height of the ball at 1.25 s and at 2.75 s.

d) Verify your equation using quadratic regression.

4. A parachutist jumps from an altitude of 2000 m. This table shows the distance of the parachutist from the ground after each 3 s period.

<table>
<thead>
<tr>
<th>Time (s)</th>
<th>0</th>
<th>3</th>
<th>6</th>
<th>9</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height (m)</td>
<td>2000</td>
<td>1911</td>
<td>1650</td>
<td>1215</td>
<td>608</td>
</tr>
</tbody>
</table>

a) Create a scatter plot for the data, and draw a curve of good fit.
b) Determine an equation for your curve of good fit.
c) Use your equation to estimate the parachutist’s distance from the ground after 10 s.

5. A school custodian found a tennis ball on the roof of the school and threw it to the ground below. The table shows the height of the ball above the ground as it moved through the air.

<table>
<thead>
<tr>
<th>Time (s)</th>
<th>Height (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>5.00</td>
</tr>
<tr>
<td>0.5</td>
<td>11.25</td>
</tr>
<tr>
<td>1.0</td>
<td>15.00</td>
</tr>
<tr>
<td>1.5</td>
<td>16.25</td>
</tr>
<tr>
<td>2.0</td>
<td>15.00</td>
</tr>
<tr>
<td>2.5</td>
<td>11.25</td>
</tr>
<tr>
<td>3.0</td>
<td>5.00</td>
</tr>
</tbody>
</table>

a) Create a scatter plot, and draw a curve of good fit.
b) Determine an equation for your curve of good fit.
c) Use your equation to predict the height of the ball at 1.25 s and at 2.75 s.
Lesson 3.5 Extra Practice Answers

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

2. a) \[ \text{Height of a Soccer Ball vs. Time} \]

   b) \( y = -6.2(x - 2) \)

3. a) \[ \text{Skateboard Experiment} \]

   b) Answers may vary, e.g., \( y = -0.54x^2 + 15.1 \)

   c) \begin{align*}
   &\text{QuadReg} \\
   &a = -5.431255431 \\
   &b = 16.197222511 \\
   &c = 15.03146531
   \end{align*}

4. a) \[ \text{Parachute Jump} \]

   b) Answers may vary, e.g., \( y = -9.6(x - 14.4)(x + 14.4) \)

   c) Answers may vary, e.g., about 1031 m

5. a) \[ \text{Tennis Ball Thrown from Roof} \]

   b) \( y = -5(x + 0.3)(x - 3.3) \)

   c) At 1.25 s, the height is about 15.9 m.

   At 2.75 s, the height is about 8.4 m.
1. State whether each relation is quadratic. Justify your decision.
   a) \( y = x^2(x + 1) \)
   b) \[
   \begin{array}{c|cccc}
   x & -7 & -6 & -5 & -3 \\
   \hline
   y & -46 & -33 & -22 & -13 \\
   \end{array}
   \]
   c) \( y = 3x(x - 5) \)

2. Discuss how you know the direction that a parabola opens if you are given an equation for the parabola.

3. Graph each quadratic relation, and determine
   i) the equation of the axis of symmetry
   ii) the coordinates of the vertex
   iii) the \( y \)-intercept
   iv) the zeros
   a) \( y = -x^2 - 2x + 8 \)   b) \( y = x^2 + 5x \)

4. Can two parabolas have the same zeros but different minimum values? Explain your reasoning.

5. Alicia knows that \((-6, 36)\) and \((1, 36)\) lie on the parabola defined by \( y = -2x^2 - 10x + 48 \). What are the coordinates of the vertex?

6. The zeros of a parabola are \(-9\) and \(3\), and the \( y \)-intercept is \(-54\).
   a) Determine an equation for the parabola.
   b) Determine the coordinates of the vertex.

7. Determine an equation for each parabola.
   a) The \( x \)-intercepts are \(-7\) and \(5\), and the \( y \)-coordinate of the vertex is \(36\).
   b) The \( x \)-intercepts are \(-2\) and \(6\), and the \( y \)-coordinate of the vertex is \(-16\).
   c) The zeros are at \(-5\) and \(3\), and the \( y \)-intercept is \(-7.5\).
   d) The vertex is at \((-3, 0)\), and the \( y \)-intercept is \(-6\).

8. Expand and simplify each expression.
   a) \((x - 2)(x + 2)\)   d) \((x - 5)(x - 2)\)
   b) \((5x - 1)(x + 3)\)   e) \((5x + 3)(4x - 2)\)
   c) \((3x - 4y)(2x + 7y)\)   f) \((7x + 3y)(3x - 4y)\)

9. Expand and simplify.
   a) \(-3(x - 2)^2\)   c) \(2(x - 1)(3x + 2)\)
   b) \(-(3x - y)(x - 4y)\)   d) \(3(5x - y)^2\)

10. Determine an equation for the parabola. Express the equation in standard form.

11. A ball is tossed straight up into the air. Its height is recorded every 0.25 s, as given in the table below.

<table>
<thead>
<tr>
<th>Time (s)</th>
<th>Height (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>1.5</td>
</tr>
<tr>
<td>0.25</td>
<td>3.5</td>
</tr>
<tr>
<td>0.50</td>
<td>4.9</td>
</tr>
<tr>
<td>0.75</td>
<td>5.7</td>
</tr>
<tr>
<td>1.00</td>
<td>5.7</td>
</tr>
<tr>
<td>1.25</td>
<td>5.2</td>
</tr>
<tr>
<td>1.50</td>
<td>4.1</td>
</tr>
<tr>
<td>1.75</td>
<td>2.4</td>
</tr>
<tr>
<td>2.00</td>
<td>0.0</td>
</tr>
</tbody>
</table>

   a) Create a scatter plot, and then draw a curve of good fit.
   b) Is your curve of good fit a parabola? Explain.
   c) Determine an equation for your curve of good fit. Express your equation in standard form.
   d) Estimate the time when the ball reaches its maximum height. Then use your equation to calculate its maximum height.

12. Evaluate each expression. Express your answer in rational form.
   a) \( 2^{-4} \)   c) \(-5^{-2} \)   e) \((-4)^0 \)
   b) \( \left( \frac{1}{3} \right)^{-2} \)   d) \(-\left( \frac{4}{5} \right)^{-3} \)
   f) \(-\left( \frac{-1}{2} \right)^{-3} \)

13. Which do you think is greater: \( 2^{-3} \) or \( 3^{-2} \)? Justify your decision.
Chapter 3 Review Extra Practice Answers

1. a) no; degree 3
b) yes; all the second differences are –2;
   first differences: –13, –11, –9, –7
c) yes; degree 2

2. If the value of \(a\) (the coefficient of \(x^2\)) is positive, then the parabola opens upward. If the value of \(a\) is negative, then the parabola opens downward.

3. a) i) \(x = -1\)
   ii) \((-1, 9)\)
   iii) 8
   iv) \(-4, 2\)

   b) i) \(x = -2.5\)
   ii) \((-2.5, -6.25)\)
   iii) 0
   iv) 0, –5

4. Two parabolas can have the same zeros but different minimum values if the value of \(a\), the coefficient of \(x^2\), is different.

5. \((-2.5, 60.5)\)

6. a) \(y = 2(x - 3)(x + 9)\)
   b) \((-3, -72)\)

7. a) \(y = -(x - 5)(x + 7)\)
   b) \(y = (x + 2)(x - 6)\)
   c) \(y = \frac{1}{2} (x - 3)(x + 5)\)
   d) \(y = -\frac{2}{3} (x + 3)^2\)

8. a) \(x^2 - 4\)
   b) \(5x^2 + 14x - 3\)
   c) \(6x^2 + 13xy - 28y^2\)
   d) \(x^2 - 7x + 10\)
   e) \(20x^2 + 2x - 6\)
   f) \(21x^2 - 19xy - 12y^2\)

9. a) \(-3x^2 + 12x - 12\)
   b) \(-3x^2 + 13xy - 4y^2\)
   c) \(6x^2 - 2x - 4\)
   d) \(75x^2 - 30xy + 3y^2\)

10. \(y = 2x^2 + 12x + 10\)

11. a)

   b) Answers may vary, e.g., yes, the curve is a U shape.
   c) Answers may vary, e.g., \(y = -5x^2 + 9.25x + 1.5\)
   d) Answers may vary, e.g., about 0.9 s; about 5.8 m

12. a) \(\frac{1}{16}\)
   b) 9
   c) \(-\frac{1}{25}\)
   d) \(-\frac{125}{64}\)
   e) -1
   f) 8

13. \(2^{-3}\) is greater because \(2^{-3} = \frac{1}{8}\) and \(3^{-2} = \frac{1}{9}\). Both have 1 as a numerator, but \(2^{-3}\) has a lesser denominator so it is greater.
1. Which ordered pair is the solution to the linear system $2x + y = 15$ and $5x - 6y = -22$?
   A. (3, 11)
   B. (4, 7)
   C. (2, 11)
   D. (5, 5)

2. Jennifer has $3.25 in her piggy bank. She has eight more nickels than dimes. If $n$ represents the number of nickels and $d$ represents the number of dimes, which linear system models this situation?
   A. $10n + 5d = 325$
   C. $5n + 10d = 325$
   B. $10n + 5d = 8$
   D. $5n + 10d = 325$

3. Amy bought 9 tickets to a movie and spent $83. She bought a combination of child tickets and adult tickets. The child tickets cost $7 each, and the adult tickets cost $11 each. How many adult tickets did Amy buy?
   A. 5
   B. 4
   C. 6
   D. 3

4. The endpoints of the diameter of a circle are $M(15, -21)$ and $N(-8, 9)$. Which point is the centre of the circle?
   A. $(11.5, -15)$
   B. $(3.5, -6)$
   C. $(-7.5, 5)$
   D. $(-3.5, 7.5)$

5. Line segment $AB$ has endpoints $A(7, -20)$ and $B(-2, -9)$. Which pair of points forms a line segment that is the same length?
   A. $(-20, 7)$ and $(2, 9)$
   B. $(12, 6)$ and $(-3, 5)$
   C. $(-7, 20)$ and $(9, 2)$
   D. $(-12, -6)$ and $(-3, 5)$

6. What is the equation of a circle that has a diameter with endpoints $(12, -7)$ and $(-12, 7)$?
   A. $x^2 + y^2 = 95$
   B. $x^2 + y^2 = 84$
   C. $x^2 + y^2 = 193$
   D. $x^2 + y^2 = 25$

7. What are the coordinates of the vertex of the parabola for the relation $y = 3(x - 5)(x + 7)$?
   A. $(1, -96)$
   B. $(-1, -108)$
   C. $(6, 39)$
   D. $(-1, -105)$

8. What is the equation of the axis of symmetry of the parabola for the relation $y = -2(x - 4)(x - 6)$?
   A. $x = -5$
   B. $x = 10$
   C. $x = -10$
   D. $x = 5$

9. A quadratic relation has zeros at $x = -10$ and $x = 25$, and passes through $(10, 150)$. Which equation describes this relation?
   A. $y = -0.5(x + 25)(x - 10)$
   B. $y = (x - 25)(x + 10)$
   C. $y = -2(x - 25)(x + 10)$
   D. $y = -0.5(x - 25)(x + 10)$

10. Which expression is the product of $(5x + 2)$ and $(7x - 4)$?
    A. $35x^2 - 6x - 8$
    B. $35x^2 + 6x + 8$
    C. $12x^2 + 34x - 8$
    D. $35x^2 + 34x - 6$

11. What is the value of $(-5)^{-3}$?
    A. $\frac{1}{125}$
    B. $-125$
    C. $-\frac{1}{125}$
    D. $-\frac{1}{15}$
Chapters 1–3 Cumulative Review Extra Practice Answers

1. B
2. C
3. A
4. B
5. D
6. C
7. B
8. D
9. D
10. A
11. C