Chapter 1 Quadratic Functions

Prerequisite Skills

Answer these questions to check your understanding of the Prerequisite Skills concepts on pages 4–5 of the *Functions and Applications 11* textbook.

Substitute into Equations

1. Find the value of y when $x = 0$.

a) $y = -2x + 7$ **b)** $y = -0.5x^2 - 8x - 2$ **c)** $y^2 = x + 4$ **d)** $-6x + y = -15$

2. Find the value of y.

a) $y = -4x - 5$ when $x = 2$

b) $y = -0.5x^2 - 6x + 1$ when $x = -2$

c) $2x - 7y = 8$ when $x = -1$

d) $2xy + x^2 = -3$ when $x = -3$

Create Tables to Draw Graphs

3. Copy and complete each table. Then graph each relation on grid paper. Use a graphing calculator to verify your graphs.

a) $y = 5x - 5$

x	y
−2	
−1	
0	
1	
2	

b) $y = -2x^2 + 3x - 4$

x	y
−2	
−1	
0	
1	
2	

Calculate First and Second Differences

To find the differences, subtract the proceeding value from the previous value.

4. Copy and complete each table.

a) $y = 3x - 2$

x	y	First Difference	Second Difference
−3			
−2			
−1			
0			
1			
2			
3			

b) $y = 2x^2 - 9$

x	y	First Difference	Second Difference
−3			
−2			
−1			
0			
1			
2			
3			

Transformations

5. Graph the quadratic relation $y = x^2$ on grid paper. Draw the following on the same set of axes.

a) the image of the graph after a translation of 3 units to the right and 2 units up

b) a reflection of the graph in part a) through the x-axis

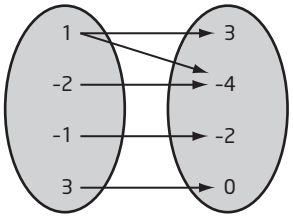
1.1 Identify Functions

Textbook pp. 6–14

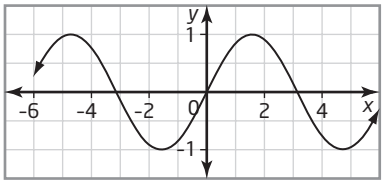
Prerequisite Skills

1. For each relation, determine if it is a function. Explain how you know.

a)



b)



c)

x	-2	-1	0	1	2
y	5	2	1	2	5

d) $4 + y^2 = x$

2. For each relations are functions. Explain or show how you know.

a) $y = -x + 2$ **b)** $y = 0.5x^2 + 6x - 1$ **c)** $y^2 = x - 3$ **d)** $-2x + 3y = -5$

A

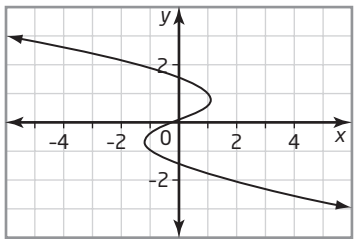
1. Determine if each relation is a function. For those that are not explain why.

a)

x	-1	0	1	2	3
y	2	0	2	4	6

b) $y^2 = x$

c)



2. A relation can be expressed as a set of ordered pairs. Which set represents a function? How do you know?

a) {(1, 1), (4, 2), (9, 3), (16, 4), (25, 5)}
b) {(0, 4), (1, 4), (2, 4), (3, 4), (4, 4)}
c) $\{(-2,4),(-1,1),(0,0),(-1,-1),(-2,-4)\}$

B

3. Evaluate, given $f(x) = 2x^2 - 5x + 3$.

a) $f(2)$ **b)** $f(0)$ **c)** $f(-3)$

4. The height h, in metres, of a rock t seconds after being dropped from the top of a cliff is modelled by $h(t) = -4.9t^2 + 122.5$.

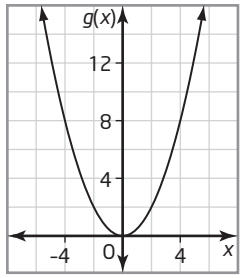
a) Graph the rock's Height versus Time to show the path of the ball. Is the relation a function? Explain.

b) What is the height of the rock at the instant it is dropped?

c) Evaluate $h(5)$ and describe in words the meaning of the result.

C

5. The graph represents the function $g(x) = ax^2$.



a) Find the value of a.

b) Find the value of $g(4)$.

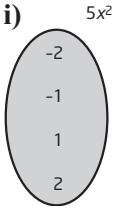
c) Find the value of $g(g(-2))$.

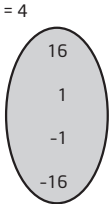
6. If $h(x)$ represents a linear function, and $h(0) = 5$ and $h(1) = -2$, then find an expression for $h(x)$.

> Use the linear function $h(x) = ax + b$.

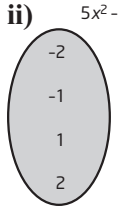
7. **a)** Copy and complete the mapping diagrams.

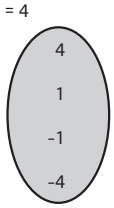
i) $5x^2 - y = 4$





ii) $5x^2 - y^2 = 4$





b) Which relation in part a) is a function? Why?

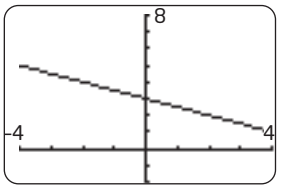
1.2 Domain and Range

Textbook pp. 15–22

Prerequisite Skills

1. Write the domain and range of each relation.

a) $\{(-1, 2), (0, 0), (1, -2), (2, -4)\}$ **b)** $y = x$ **c)**



2. An apple falls from a height of 20 m above the ground and strikes the ground 2 s later. The apple's height, in metres, is graphed versus time, in seconds.

a) Write the domain of the relation.

b) Write the range of the relation.

c) Describe the restrictions placed on the domain and range for this relation.

3. An athlete is participating in a 100-m dash. When the race begins, the athlete remains stopped for 5 s, and then sprints toward the finish at a constant speed of 5 m/s.

a) Sketch a graph of Distance from Finish versus Time for the relation that models the athlete's run.

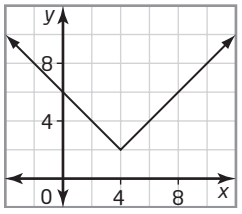
b) Write the domain and range of the relation.

A

1. Write the domain and range of each relation.

a) $\{(-4, 2), (-3, 1), (-2, 2), (-1, 1), (0, 0)\}$

b)



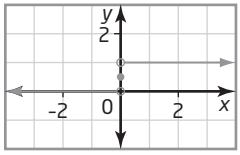
c) $x^2 + y = 0$

d) $f(x) = 5x + 5$

2. For the function $f(x) = \sqrt{x}$, express the domain and range in words and as intervals.

B

3. The graph shows the Heaviside step function, or unit step function. It can be used to represent a switch being turned on. The open point at the end of a line segment means that its coordinates are not included in the domain or range of the function.



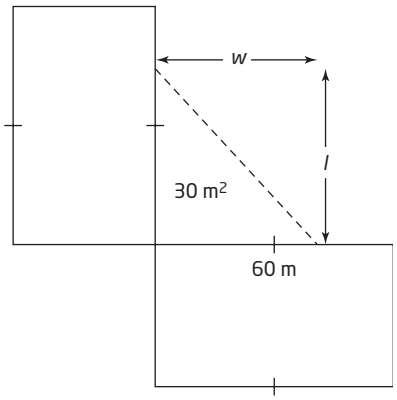
a) What is the value of y when $x = 0.5$? when $x = -0.5$?

b) Determine the value of y when $x = 0$.

c) Explain why the graph represents a function.

d) Write the domain and range of the function.

4. Two barns that are 60 m long meet at a right angle, as shown. A triangular pen with an area of 30 m^2 is to be created by connecting the barns with a fence.



a) Create a table of values using the length of the pen, ℓ, as the independent variable. Use this table to help you.

Length, l (m)	Width, w (m)	Area $= \ell \times w$ $= 30\ m^2$

b) Sketch a graph of Width versus Length.

c) Which describes your graph, a series of dots, a line segment, or a curve? Explain.

d) Express the domain and range in words and as intervals.

e) How will the domain and range change if the area of the pen is to be 15 m^2?

Write an equation for the length ℓ, in terms of the width w. What restrictions are placed on the length and width?

5. A flare is shot upward from the deck of a large ship. Its height above the water h, in metres, t seconds after being shot is modelled by $h = -4.9t^2 + 29.4t + 34.3$.

a) Complete the table that relates t and h.

Time, t (s)	Height, h (m)
0	
1	
2	
3	
4	
5	
6	
7	

b) From the table, find the maximum height of the flare.

What is the greatest height in the table?

c) From the table, determine how long the flare is in the air. Assume that the flare lands in the water.

When the flare lands in the water, what is the height of the flare above ground?

d) Write the domain and range of the function.

C

6. $g(x) = 6x - 7$ and $f(x) = \frac{1}{2}x^2$.

a) Write an expression for $g(f(x))$.

b) Is the relation $g(f(x))$ a function? Explain.

c) Write the domain and range of $g(f(x))$.

1.3 Analyse Quadratic Functions

Textbook pp. 23−30

Prerequisite Skills

1. A snowboarder jumps off a ledge. The height of the snowboarder is recorded at regular intervals for 1.50 s. The table shows the results.

Time (s)	Height (m)
0.00	10.40
0.25	11.24
0.50	11.48
0.75	11.09
1.00	10.10
1.25	8.49
1.50	6.28

a) Use the table to estimate the maximum height of the snowboarder.

b) Use a graphing calculator to draw a scatter plot of Time versus Height.

Refer to the Technology Appendix in the student text, page 454.

c) Use the scatter plot to estimate the height of the snowboarder 2 s after she jumps off the ledge.

d) Use the QuadReg operation to find an equation for the relation.

After creating your scatter plot, press START, then cursor over to the **CALC** menu. Then select **5:QuadReg.** Press 2nd 1 for L1, then , . Press 2nd 2 for L2, then , . Press VARS, then cursor over to the **Y-VARS** menu. Select **1:Y1**. Press ENTER

e) Use the equation to find the height of the snowboarder 2 s after she jumps off the ledge.

f) Do your answers to parts b) and d) agree? Explain.

2. Copy and complete each table. Identify the relation as linear or quadratic.

a)

x	y	First Difference	Second Difference
−3	127		
−2	139		
−1	151		
0	163		
1	175		
2	187		
3	199		

b)

x	y	First Difference	Second Difference
−3	27		
−2	17		
−1	11		
0	9		
1	11		
2	17		
3	27		

A

1. Determine if each equation represents a linear or quadratic function.

a) $y = 3x + 5$

b) $f(x) = x^2 - 11$

c) $6y - x = 11$

d) $h(t) = 49.0t - 4.9t^2$

e) $y = 3(x - 1)^2$

f) $g(x) = \frac{4}{5}x + 7$

g) $y = -3$

h) $f(x) = -5 + 0.5x$

2. For each set of data, identify the relation as linear, quadratic, or neither. Calculate the first differences and second differences, if necessary.

a)

x	y
0	−2
1	13
2	28
3	43
4	58

b)

Time (s)	Height (m)
1	117.6
2	102.9
3	78.4
4	44.1
5	0.0

c)

Time (years)	Savings ($)
1	15 900
2	16 854
3	17 865
4	18 937
5	20 073

B

3. The height $h(t)$, in metres, of a baseball t seconds after being hit from a certain height is modelled by $h(t) = -4.9(t - 4)^2 + 79$.

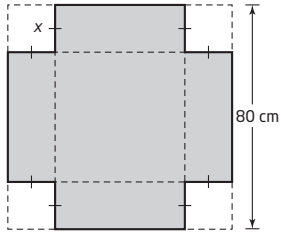
a) Create a table of values for $t = 0, 1, 2, \ldots, 8$.

b) Determine whether $h(t)$ is quadratic.

c) Use the table to graph $h(t)$.

d) Identify the axis of symmetry, direction of opening, the coordinates of the vertex, the domain, and the range.

4. A square-based box with an open top is to be made from a square piece of cardboard that has side length 80 cm. The piece of cardboard has squares cut out at the corners as shown.



a) Let x represent the side length of each cut-out square in whole units. What are the possible values of x? Explain.

b) Determine an expression for the area of cardboard used to make the box.

c) If the area of cardboard used is to be 5500 cm^2, find the height of the box.

5. Research results for a golf course show that 500 people will buy memberships if the price is $800 per membership. For each $40 increase in price, 50 fewer people will buy a membership. The function that models the revenue of the golf memberships is: $R(x) = (500 - 50x)(800 + 40x)$, where x represents the number of $40 price increases.

a) Expand the function. Is it quadratic?

b) Graph the function using a graphing calculator. Is the graph a parabola?

c) Use the graph to determine the membership price that will produce the maximum revenue.

C

6. How many line segments are required to connect the vertices in a 20-sided polygon?

> Think: How many line segments are required to connect one vertex to all of the others?

7. Exactly 24 new tiles are to be put on a bathroom floor. Each tile measures s cm × s cm, where s is an integer number greater than 10. Each tile has a 5 cm red border painted on it. Find an expression for the area of the tiles that are not painted in red.

1.4 Stretches of Functions

Textbook pp. 31–39

Prerequisite Skills

1. For each function, describe in words the transformation relative to $y = x^2$ and then sketch the graph.

a) $y = \frac{1}{4}x^2$

b) $y = -x^2$

2. The point (6, 24) is on the graph of the function $y = ax^2$. Find the value of a. Copy and complete the solution and solve for a.

$y = ax^2$

$24 = a(6^2)$

3. The graph of $f(x) = x^2$ is stretched vertically by a factor of 2 and then reflected in the x-axis. Find the coordinates of two points on the graph that results from the transformations. Copy and complete the solution.

$f(x) =$ ☐x^2 A vertical stretch of x^2 by 2.

$=$ ☐x^2 A reflection in the x-axis.

If $x = 1$, then transformed $f(x) =$ ☐. $(x, y) = (1,$ ☐$)$

If $x = -2$, then transformed $f(x) =$ ☐. $(x, y) = (-2,$ ☐$)$

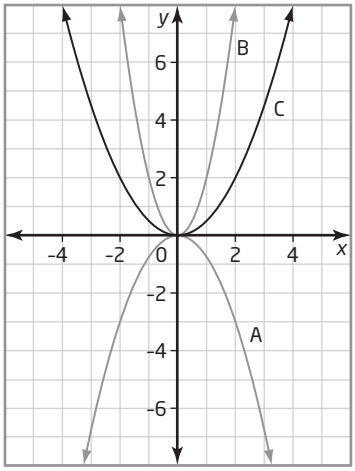
A

1. Match each equation to the corresponding graph.

a) $y = 2x^2$

b) $y = 0.5x^2$

c) $y = -0.75x^2$



2. Graph these three functions on the same set of axes. Label the graphs.

Create a table of values and graph.

a) $f(x) = x^2$

b) $g(x) = -4x^2$

c) $h(x) = \frac{5}{4}x^2$

3. Draw a graph for $y = x^2$. Then, draw the graph of each transformation relative to the graph of $y = x^2$.

a) a vertical stretch by a factor of 1.5

b) a compression by a factor of 0.6

c) a reflection in the x-axis and then a compression by a factor of $\frac{1}{4}$

d) a reflection in the y-axis and then a vertical stretch by a factor of 2

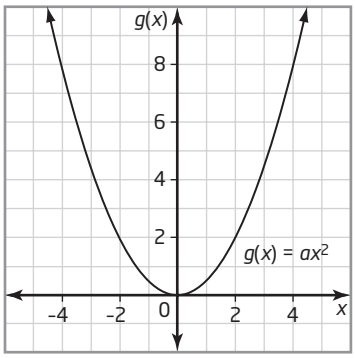
4. Write an equation for the graph that results from each transformation.

a) The graph of $f(x) = x^2$ is compressed vertically by a factor of 0.9.

b) The graph of $p(x) = x^2$ is stretched vertically by a factor of 20.

c) The graph of $q(x) = x^2$ is stretched vertically by a factor of 7 and then reflected in the x-axis.

5. The graph of the function $g(x) = ax^2$ is shown. What is the value of a?



B

6. On Ganymede, the largest moon of Jupiter, the vertical distance fallen by a free-falling object is represented by the function $d(t) = 0.71t^2$, where d is the vertical distance fallen, in metres, and t is the time, in seconds.

a) How far does an object fall during the first second on Ganymede?

b) How long does it take an object to fall 100 m on Ganymede?

c) Compare the graph of the function $d(t) = 0.71t^2$ to the graph of $y = x^2$ by letting y represent $d(t)$ and x represent t.

7. Write an equation for a parabola that has its vertex at the origin and passes through the point $(-3, -6)$.

C

8. A cannonball is shot into the air at an angle of 45° from the horizontal. It lands at a point 150 m away from where it was shot. Under which conditions will the path of a second cannonball represent a vertical compression of the path of the first cannonball?

> Try drawing a graph of the path of each cannonball and translating each to a common vertex.

a) increasing the angle to 75°

b) decreasing the angle to 15°

c) increasing the velocity of the cannonball

d) decreasing the velocity of the cannonball

9. **a)** On the same set of axes, sketch the graphs of $y = x^2$ and $y = \frac{1}{3}x^2$.

b) Compare the graphs of $y = x^2$ and $y = \frac{1}{3}x^2$.

c) Based on your answer for part b), how would you describe the graph of $y = 3x^2$ relative to the graph of $y = x^2$.

1.5 Translations of Functions

Textbook pp. 40–46

Prerequisite Skills

1. For each of the following functions:

i) Describe in words the transformation relative to the graph of $f(x) = x^2$.

ii) Write the coordinates of the vertex.

iii) Sketch the graph. Label the vertex and one other point.

a) $f(x) = x^2 - 2$

b) $g(x) = (x - 4)^2$

c) $h(x) = (x + 3)^2 + 1$

d) $y = (x - 1)^2 + 5$

2. Two points on the graph of the function $f(x) = (x - h)^2 + k$ are (5, 2) and (1, 2). Plot these points on a coordinate grid. Describe how you find the coordinates of the vertex.

3. a) Sketch the graphs of $y = x^2 + 6$, $y = x^2 + 2$, and $y = x^2 - 2$ on the same set of axes.

b) Each of the three functions in part a) is translated 2 units to the left. What are the new equations of the functions?

c) Each of the three functions in part a) is translated 2 units down. What are the new equations of the functions?

A

1. Match each equation to the corresponding graph.

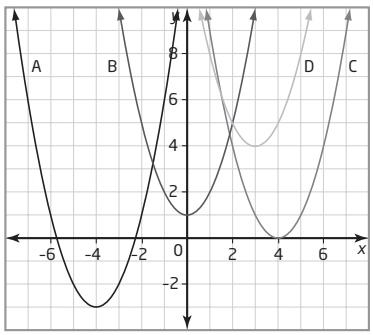
> Check the key features of each graph: vertex, y-intercept, and x-intercepts.

a) $f(x) = (x - 4)^2$

b) $g(x) = (x + 4)^2 - 3$

c) $h(x) = (x - 3)^2 + 4$

d) $k(x) = x^2 + 1$



2. Write an equation for the graph resulting from each transformation.

a) The graph of $f(x) = x^2$ is translated 10 units to the left.

b) The graph of $g(x) = x^2$ is translated 10 units up.

c) The graph of $s(x) = x^2$ is translated 1 unit to the right.

d) The graph of $v(x) = x^2$ is translated 1 unit down.

3. Write the coordinates of the vertex in each graph. Then, sketch each graph.

a) $f(x) = x^2 - 6$

b) $g(x) = (x - 5)^2$

c) $h(x) = (x + 3)^2 - 9$

d) $k(x) = (x - 1)^2 + 3$

4. Write the coordinates of the vertex in each graph.

a) $f(x) = x^2 + 10$

b) $g(x) = (x + 8)^2$

c) $h(x) = (x - 12)^2 - 2$

d) $k(x) = (x + 6)^2 + 6$

B

5. The x-intercepts of a parabola that opens upward are -2 and 4.

a) What is the x-coordinate of the vertex?

b) Find the equation of the parabola in the form $q(x) = (x - h)^2 + k$.

6. The x-intercepts of a parabola that opens downward are -4 and 2.

a) What is the x-coordinate of the vertex?

b) Find the equation of the parabola in the form $q(x) = (x - h)^2 + k$.

7. Two friends are ready to bungee jump from a platform. There is a period of 3 min between their jumps. How are the position-time graphs for the two friends alike? How are they different?

8. The graph of $f(x) = x^2$ is translated 3 units to the right and 9 units down.

a) Write an equation for the graph resulting from the transformation.

b) Sketch the graph.

c) What are the coordinates of the vertex?

d) What are the x-intercepts?

9. The graph of $g(x) = \sqrt{x}$ is translated 4 units to the right and 3 units down.

a) Write an equation for the graph resulting from the transformation.

b) Sketch the graph.

c) Write the domain and range of the translated function.

C

10. The equation of a circle with radius 2 is given by $x^2 + y^2 = 4$. What will be the equation of the circle after a translation of 4 units to the left?

11. a) Write the coordinates of the vertex of the graph $f(x) = 3(x + 2)^2 + 2$. How can you verify your answer?

b) The vertex of a parabola is at (5, 0). The parabola passes through the points (6, 2), (7, 8), and (9, 18). Find the equation of the parabola.

1.6 Sketch Graphs Using Transformations

Textbook pp. 47–53

Prerequisite Skills

1. For the graph of the quadratic function $f(x) = 2(x + 3)^2 - 4$:

a) Describe the transformations relative to the graph of $f(x) = x^2$.

Copy and complete the statements.

The vertex of the graph is (☐, ☐).

Therefore, the graph of $f(x) = x^2$ is shifted ☐ units right/left and up/down ☐ units.

The value of a is ☐. So the graph is vertically stretched/compressed by a factor of ☐.

b) Write the coordinates of the vertex. $(h, k) =$ (☐, ☐)

c) Write the equation of the axis of symmetry. $x =$ ☐

d) Sketch the graph. Label the vertex and two other points.

e) Write the domain and range of the function.

Domain $= \{x \in \mathbb{R} \mid$ ☐$\}$

Range $= \{y \in \mathbb{R} \mid$ ☐$\}$

2. Describe the graph of the function $y = -2(x + 5)^2 + 2$ in terms of transformations on the graph of $y = x^2$.

3. **a)** Sketch the graphs of the three functions on the same set of axes.

i) $f(x) = -(x - 3)^2 + 4$

ii) $g(x) = (x - 3)^2 - 4$

iii) $h(x) = 2(x - 3)^2 - 8$

b) Describe how the graphs of the three functions are related.

A

1. For each parabola, write:

- the coordinates of the vertex
- the equation of the axis of symmetry
- the direction of opening
- the range of the function

a) $f(x) = -2x^2 + 10$

b) $g(x) = -5(x + 6)^2$

c) $h(x) = 8(x - 2)^2 + 12$

d) $y = 0.25(x + 4)^2 - 9$

2. Describe the graph of each function in terms of transformations on the graph of $y = x^2$. Then, sketch the graph. Label the vertex, the axis of symmetry, and one other point. Check your result with a graphing calculator.

a) $f(x) = 4(x - 6)^2$

b) $g(x) = -2x^2 - 2$

c) $h(x) = 3(x - 3)^2 + 7$

d) $y = -5(x + 1)^2 + 5$

3. The graph of $f(x) = x^2$ has been stretched vertically by a factor of 2 and translated 1 unit to the right and 5 units up.

a) Write the equation of the graph resulting from the transformations.

b) Sketch the graph of $f(x) = x^2$ and its image after the transformations.

4. Write an equation of a parabola that satisfies each set of conditions.

a) vertex $(6, -3)$
congruent in shape to the graph of $y = 5x^2$
range: $\{y \in \mathbb{R} \mid y \geq -3\}$

b) vertex $(-4, -1)$
y-intercept: 7

c) opens downward
congruent in shape to the graph of $y = 3x^2$
x-intercepts: -4 and 0

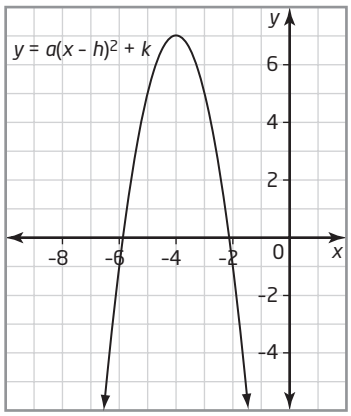
B

5. a) Write the coordinates of two points other than the vertex on the graph of $f(x) = 0.5x^2$.

b) Explain how these points can help you draw the graph of $g(x) = 0.5(x + 8)^2 + 12$.

c) Sketch a graph the function $g(x) = 0.5(x + 8)^2 + 12$. Label the vertex and the axis of symmetry and write the domain and range.

6. The graph of a parabola is shown.



a) Identify the vertex of the parabola.

b) Write an equation that models the parabola in the form $y = a(x - h)^2 + k$.

7. The height, in metres, of a football t seconds after being kicked is modelled by the function $h(t) = -4.9(t - 2.5)^2 + 31.1$.

a) From what height is the ball kicked?

b) What is the maximum height of the football and when does this occur?

c) Write the range of this function.

d) Use a graphing calculator to graph the function. Determine how long it takes the football to land.

e) Write the domain of the function.

8. Write an equation of a parabola that satisfies each set of conditions.

a) axis of symmetry: $x = -2$
y-intercept: -3
one x-intercept is -3

b) axis of symmetry: $x = 3$
y-intercept: 4
one x-intercept is 2

> You may need to use a system of equations to find the equation.

C

9. A badminton player hits a shuttle when it is at a height 1 m. The shuttle follows a parabolic path and reaches a maximum height of 5 m before being hit by an opponent at a point 8 m from the player and 1 m above the ground.

> Try creating a function that models the path of the shuttle.

a) Sketch a graph of the path of the shuttle.

b) Suppose the badminton player was 0.5 m away from the 1.5 m high net when she hit the shuttle. Would the shuttle have made it over the net? Explain. Assume the shuttle was hit in a direction perpendicular to the net.

10. The coordinates of two points on a parabola are (7, 4) and (3, 4).

a) What do you know about the parabola from these two points?

b) Another point on the parabola is (8, 24). Find the equation of the parabola $f(x) = a(x - h)^2 + k$.

Chapter 1 Review

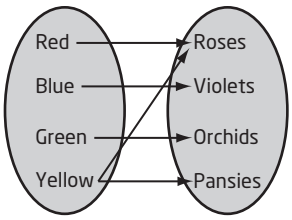
1.1 Quadratic Functions

Textbook pp. 6–14

1. Is each relation a function? How do you know?

a) $x^2 = y - 1$

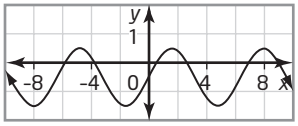
b)



c)

x	y
-2	9
-1	4
0	3
1	-1
2	5

d)



2. Evaluate, given $f(x) = -x^2 + 5x - 6$.

a) $f(2)$ **b)** $f(-1)$

c) $f\left(\frac{1}{4}\right)$ **d)** $f\left(-\frac{2}{3}\right)$

3. The height $h(t)$, in metres, of a flare that is fired vertically upwards, after t seconds can be modelled by $h(t) = -4.9t^2 + 142t$.

a) Describe, in words, the meaning of $h(5)$ in this context.

b) What is the height of the flare 3.5 s after it has been fired?

1.2 Domain and Range

Textbook pp. 15–22

4. Describe in words the domain and range of $y = -3x^2 - 1$.

5. A parabola opens upward and has its vertex located at $(-2, -4)$. Write the domain and range.

> Use set notation when writing the domain and range. For example, $\{x \in \mathbb{R} \mid -1 \leq x \leq 3\}$, $\{y \in \mathbb{R} \mid y > 0\}$.

6. A chartered bus company charges \$250 for the rental of a bus plus \$8 per passenger. The bus has a maximum seating capacity of 24. The cost of renting the bus can be modelled by $C(n) = 250 + 8n$, where n is the number of passengers. Write the domain and range of this function.

> Consider the context of the question. To what number system must the domain and range belong?

1.3 Analyse Quadratic Functions

Textbook pp. 23–30

7. Which relation(s) represent a quadratic function? Explain how you know.

a) $x = \sqrt{y}$

b) $f(x) = -1 + 3(x - 1)^2$

c) $y^2 = x^2 + 1$

8. For each set of data, identify the relation as linear, quadratic, or neither.

To determine if a relation is quadratic, calculate the first differences and second differences.

a)

x	y
−2	5
−1	2
0	1
1	5
2	2

b)

Time (weeks)	Height (cm)
0	0
1	2
2	4
3	6
4	8

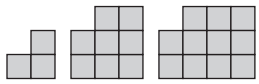
c)

Distance (km)	Rental Charge ($)
0	5
1	5
2	5
3	5
4	10
5	10
6	10

d)

Time (s)	Height (cm)
0.0	0.0
0.2	1.8
0.4	3.2
0.6	4.2
0.8	4.8
1.0	5.0
1.2	4.8
1.4	4.2

9. The diagram shows the first three terms in a pattern where each square has a side length of 1 unit.



a) Complete the table.

Base Length of Figure (unit)	Area of Figure (units^2)
1	
2	
3	
4	
5	

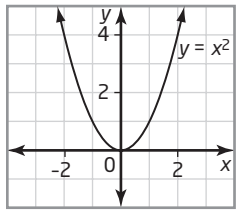
b) Determine whether the relation is linear, quadratic, or neither.

Use first differences and second differences.

1.4 to 1.6 Stretches of Functions, Translation of Functions, Sketch Graphs Using Transformations

Textbook pp. 31–53

10. For each function, describe the graph in terms of transformations on the graph of $y = x^2$. Sketch the graph and label the vertex, axis of symmetry, and one other point.



a) $y = 3x^2 - 2$

b) $m(x) = -(x + 4)^2$

c) $r(t) = 2(t - 1)^2 - 3$

11. Write an equation for the parabola that satisfies each set of conditions.

Use this form of a quadratic function,
$y = a(x - h)^2 + k$.

a) vertex at (–3, –2)
congruent in shape to graph of $y = 2x^2$
no x-intercepts

b) vertex at $(-2, 0)$
congruent in shape to graph of $y = 0.8x^2$
range $= \{y \in \mathbb{R} \mid y \geq 0\}$

Chapter 1 Practice Exam

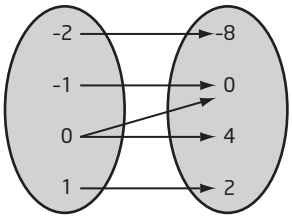
Work with a partner to check each other's work.

For questions 1 to 5, choose the best answer.

1. Which relation is a function?

A $x^2 - y^2 = 1$

B



C $\{(-1, 3), (1, -3), (2, 0), (3, -1)\}$

D $x = -8$

2. Which set of numbers best represents the range of the parabola given by $f(x) = -2(x - 1)^2 + 5$?

A $\{-13, -3, 3, 5, \ldots\}$

B $\{y \in \mathbb{R} \mid y \leq 5\}$

C any real number greater than or equal to 5

D $\{y \in \mathbb{R} \mid y \leq -1\}$

3. Which statement is not true for the parabola $g(t) = -(t + 4)^2 + 7$?

A Its vertex is located at $(-4, 7)$.

B It opens downward.

C It passes through the point $(-3, -6)$.

D Its range is any number less than or equal to 7.

4. The point $(-1.5, 1.5)$ is on the graph of the function $y = a(x + 1)^2 + 2$. What is the value of a?

A 1.5 **B** -1.5

C 2 **D** -2

5. The graph of $y = x^2$ is stretched vertically by a factor of 2 and translated 3 units up. Which equation represents the resulting graph?

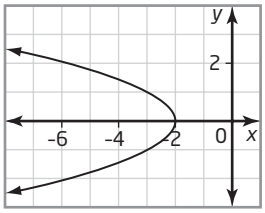
A $y = 2x^2 - 3$ **B** $y = \frac{1}{2}x^2 + 3$

C $y = -(x + 3)^2$ **D** $y = 2x^2 + 3$

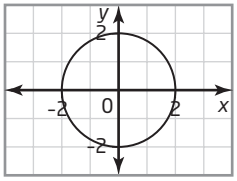
6. Determine if each relation is a function. Justify your answer.

a) $-3x + 4 = y$

b)



c)



d

x	y
-2	5
-1	4
1	4
2	5

7. Write the domain and range of each relation.

a) $y = -x + 2$ **b)** $y = -3x^2 + 2$

8. The surface area, in square centimetres, of a cone with a slant height, s, and a radius, r, is given by $S(r) = \pi rs + \pi r^2$. The slant height of a particular cone is 4.5 cm.

Draw and label a diagram to help you.

a) What is the meaning of $S(3)$ in this context?

b) Evaluate $S(3)$.

9. Write an equation for the graph resulting from each transformation.

a) The graph of $h(x) = x^2$ is translated 3 units right.

b) The graph of $f(r) = r^2$ is translated 2 units down.

c) The graph of $m(n) = -3n^2$ is translated 5 units left.

d) The graph of $p(x) = ax^2$ is translated 7 units up.

10. Write the coordinates of the vertex in each graph.

a) $h(t) = -t^2 - 1$

b) $k(h) = 3(h + 1)^2 + 1$

c) $a(r) = -2(r - 2)^2 + 9$

11. Write an equation for the parabola that satisfies these conditions.

a) vertex (0, 3)
congruent in shape to the graph of $y = x^2$
opens downward

b) vertex (2, 0)
congruent in shape to the graph of $y = x^2$
range $\{y \in \mathbb{R} \mid y \geq 0\}$

c) vertex (0, 4)
congruent in shape to the graph of $y = x^2$
opens downward
x-intercepts: -2 and 2

12. Describe the graph of each function in terms of translations on the graph of $y = x^2$.

a) $y = -x^2 - 2$

b) $y = (x + 1)^2 - 2$

c) $y = 3(x - 1)^2 + 1$

d) $y = -0.5(x + 2)^2 - 3$

13. A parabola is modelled by the function $h(x) = 3(x - 1)^2 + 3$.

a) Sketch the parabola. Label the vertex, axis of symmetry, and two other points.

b) Write the domain and range of the function.

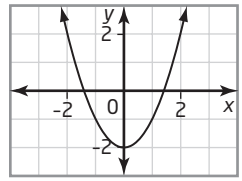
14. The graph of $P(x) = (15 - x)(120 + 3x)$ is a parabola.

a) Evaluate $P(6)$.

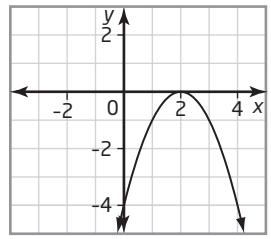
b) Use two different methods to show that the equation represents a quadratic function.

15. Each graph is the result of a translation of the graph of $y = x^2$. Match each graph with the correct description of the translation.

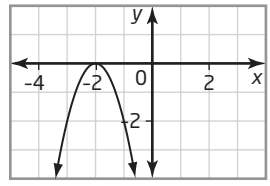
A



B



C



a) a reflection through the x-axis, then a translation 2 units right

b) a translation 2 units down

c) a vertical stretch, a reflection through the x-axis, then a translation 2 units left