## Introduction to a Quadratic Function Unit

## Big idea

The first half of this course - the first four units - are review of quadratics you've learned in grade 10. If you took grade 10 applied, you will learn a lot of new things in addition to what was done last year. If you took academic course you will find that there is not a lot of new material to learn. Whatever was done before, you must learn to be very proficient with working with quadratic equations as well as learn some new concepts that relate to quadratics you have never seen before. In this unit you will concentrate on the following topics that are outlined in the table below. (The review topics in the table are from BOTH academic and applied course.)

|  | Place a $\checkmark$ if you are confident in that section. Place a $\approx$ if you are just ok in that section. Leave it blank if you are lost in that section. <br> If there are gaps in any row, please see the teacher for extra help in that topic. | Success Criteria <br> Assessment as Learning for Learning and of Learning |  |  |  |  |  |  |  |
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| KU | Learning Goal |  | $\overline{K U}$ | APP | COMM | TIPS | (8) | HW |  |
|  | Characteristics of Functions Section 1.1 \#2,4,7,10,12,13 |  |  |  |  |  |  |  |  |
|  | Lines and Quadratics \& Function Notation Section 1.2 \#1,2,5,6,8 \& EXTRA Handout |  |  |  |  |  |  |  |  |
|  | Working with Function Notation Section 1.3 \#3,4,5,6, 13,15 |  |  |  |  |  |  |  |  |
|  | Transformations of Quadratics INVESTIGATION with Graphing Calculators Section 1.5 \#1,2 i,ii, 3,5,6,9,10 \& EXTRA Handout |  |  |  |  |  |  |  |  |
|  | Sketching Quadratics using Transformations Section 1.6 \#5,7def,10,11 \& EXTRA Handout |  |  |  |  |  |  |  |  |
|  | Domain and Range <br> Section 1.7 \#2,3,6,7,8,9 |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
|  | EXTRA - domain\& range activity |  |  |  |  |  |  |  |  |

Tentative TEST date $\qquad$
Reflect - TEST mark for this unit $\qquad$ Overall mark now $\qquad$ .
Looking back on this unit, what should you plan to improve upon before the exam?
Corrections for wrong textbook answers:
$\qquad$

## Characteristics of Functions

1. Mathematics is a study of relationships. These relationships when written with variables are called relations. Sometimes a problem may relate variables that have interdependence. We usually call $\qquad$ variable as independent and the $\qquad$ variable the dependent. The independent variable can also be called the $\qquad$ and dependent variable the $\qquad$ . This terminology is often used when the relations are functions.
2. What is a function? (Explain using the input/output terminology, as well as explain how to determine if it is a function from an equation and from a graph.)
3. Define the terms domain and range.
4. Find the domain and range then determine if the following are functions or not.
a. mapping diagrams

b.

e.


C.


Date:
18
g. points
$\{(-3,9),(-2,8),(-1,2),(-2,-4)\}$
h.
$\{(2,5),(3,5),(4,10),(5,0)\}$
k. equations
$y=3-6 x$


Name: $\qquad$
j.

m.
$x^{2}+y^{2}=4$
p.

The forensic office analyzing DNA, is trying to determine the identity of a person it belongs to.

For which pair of related quantities would time be the independent variable?
a. grade, time spent on project
c. flight time, rainfall
b. length of race, finish time
d. distance to work, commute time

Date: $\qquad$

## Lines and Quadratics \& Function Notation

1. What is function notation?
2. You have seen function notation for specific functions, but you just didn't know it. Indicate what is the name of the function, the input and the output of each of the following
a. $\cos (\theta)$.
b. $\sin ^{-1}(0.5)$
c. $\sqrt[3]{(9)}$
3. What could function notation be confused with?
4. Explain why it is incorrect to write the following, give corrected versions.
a. $\quad \cos =\frac{1}{2}$
b.

$$
\begin{aligned}
& \tan x=0.5234 \\
& x=0.5234 \tan ^{-1}
\end{aligned}
$$

d. $(2 x)^{2}$
5. What do differences of the dependent variable tell you about the relation given?
6. Determine what type of functions are these? Specify what variable is the function of what other variable and record the output in function notation.

## 00

a.

| $x$ | $y$ |
| :---: | :---: |
| 0 | -9 |
| 2 | -10 |
| 4 | -7 |
| 6 | 0 |
| 8 | 11 |
| 10 | 26 |

b.

| $n$ | $P$ |
| :---: | :---: |
| 1 | -8 |
| 7 | 2 |
| 13 | 12 |
| 19 | 22 |
| 22 | 27 |
| 25 | 32 |

c.

| Time <br> (years) | Radiation <br> level |
| :---: | :---: |
| 1 | 17 |
| 2 | 9 |
| 3 | 5 |
| 4 | 3 |
| 5 | 2 |
| 6 | 1.5 |

d.

| Length | Area of <br> figure |
| :---: | :---: |
| 1 | 2 |
| 2 | 5 |
| 3 | 10 |
| 4 | 17 |
| 5 | 26 |
| 6 | 37 |

e.

| \# of <br> items | Cost |
| :---: | :---: |
| 10 | 7 |
| 12 | 9 |
| 14 | 11 |
| 16 | 13 |
| 18 | 15 |
| 20 | 17 |

$\qquad$
7. What is a degree of a function? How does it help you determine what type of function is given?
8. Decide what type of function is given by expanding and simplifying then determining the degree of the function.
a. 5
$f(x)=(2-x)(x+3)$
b. 18
$g(x)=5+4(x-2)-8 x$
c.
d.
$i(x)=3+x-5(x-7(x+1))$
9. The helium balloon is launched from a height of 2 meters and it rises at a rate of $0.5 \mathrm{~m} / \mathrm{s}$.
a. Write an equation in function notation for the height, h , of the balloon at time, t , seconds.
b. What is the domain and range of this function, assuming that the balloon pops at a height of 1 km .
10. Video games cost on average $\$ 8.00$ to rent. The player costs $\$ 300$. The total cost of playing video games can ge represented by a function $C(v)$.
a. Write an equation in function notation for the cost of v , video games.
b. State the degree of this function and whether it is linear or quadratic.
c. Use your equation to calculate the cost of renting 20 video games.
d. What is the domain and range of this function, assuming that you have $\$ 780$ to spend?
$\qquad$
$\qquad$
11. A skydiver's height is modelled by $h(t)=2000-4.9 t^{2}$ for $\{t \in R, 0 \leq t \leq 14\}$, where $t$ is the time elapsed, in seconds, and h is the height in meters. After 14 seconds the skydiver opens up the parachute and his descent is modelled by $h(t)=1039.6-3.5(t-14)$.
a. Use the degrees to determine what type of relations the equations are.
b. At what height was the parachute released?
c. At what time did the skydiver land on the ground?
d. Sketch the first relation on the domain of $\{t \in R, 0 \leq t \leq 14\}$ using a table of values with time increments of 2 sec. Sketch the second relation by using the two points where $t=14$ and $t=$ answer from c .

e. Show that the differences in the table for the first relation match with your answer about what type of relation it is in question a.
f. Use vertical line test to determine if the relation is a function.

Date: $\qquad$

## Function Notation

Name: $\qquad$

1. Determine $f(7)$ of each of the following

國 $f=\{(-9,7),(-7,6),(0,-7),(7,-9),(9,7)$

| $x$ | 0 | 1 | 3 | 5 | 7 |
| :---: | ---: | ---: | ---: | ---: | :--- |
| $f(x)$ | -7 | -5 | -3 | -1 | 0 |



Is the this graph a function? Explain.
2. Determine $f(-6)$ of each of the following $f=\{(-10,-6),(-9,-7),(-8,-8)$, $(-7,-9),(-6,-10)\}$

| $x$ | -6 | -4 | -2 | 0 | 2 |
| :---: | ---: | ---: | ---: | ---: | ---: |
| $f(x)$ | -6 | -6 | -6 | -6 | -6 |



Is the this graph a function? Explain.
3. For the following function determine $f(-2), f(0), f(3), f(4 x)$

$$
f(x)=x^{2}+7 x+12
$$

4. For the following function determine $f(0), f(-1), f(2), f(5 x)$

$$
f(x)=7 x^{2}-25 x+12
$$

Date:
Name: $\qquad$
5. Three consecutive even integers numbers are picked from the domain $-10 \leq x \leq 10$. The equation that models the sum of their squares is $S(x)=x^{2}+(x+2)^{2}+(x+4)^{2}$
a. What does each part of the equation represent?
b. Evaluate $S(-10)$, what does it represent?
c. Evaluate the function for all valid values of the domain. Organize results in a table.
d. Find which three numbers would give th minimum sum?
6. A pebble falls straight to the ground from a cliff that is 1102.5 m tall. The function representing the distance the pebble has fallen in meters is $d(t)=4.9 t^{2}$, where $t$ is the time the pebble has been falling in seconds.
a. Evaluate $d(3)$. What does it represent?
b. Explain what does the following tell you? $d(5)=122.5$
c. When did the pebble land on the ground?
d. What is the domain and range of this situation?
7. Explain what each part of the following tells you $m(p)=p^{2}+p$
a. Evaluate and simplify the expression for $m(1-x)$
$\qquad$

## Transformations of Quadratics - INVESTIGATION

In this investigation you will graph different parabolas and determine the link between the equation in "vertex form" $y=\underline{a}(\underline{x}-\underline{h})^{2}+\underline{k}$ and the transformations from the basic parabola $\mathrm{y}=\mathrm{x}^{2}$.

## TECHNOLOGY OPTION

To help you graph and plot the parabolas, enter the equation in the $Y=$ Use $\mathrm{X}, \mathrm{T}, \mathrm{\theta}, \mathrm{n}$ to type a variable
Remember to use GREY $(-)$ when negative appears FIRST and BLUE - otherwise $\begin{array}{lll}\text { Press } & \text { graph } & \text { to see the graph } \\ \text { Press } & 2^{\text {nd }} & \text { graph } \\ & \text { to see a table of values for the parabola }\end{array}$

## Parabola Investigation \#1

| Basic Equation |  | $y=x^{2}$ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Vertex Form $y=a(x-h)^{2}+k$ <br> Change values for a keep $\mathrm{h}=0$ and $\mathrm{k}=0$ for now |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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|  | Equations | Colour |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| $\mathrm{a}=2$ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| $\mathrm{a}=0.2$ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| $a=-1$ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| $a=-2$ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| $\mathrm{a}=-0.2$ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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Summarize what effect does $a$ have on the graph of $y=x^{2}$

1. State the transformations performed on $\mathrm{y}=\mathrm{x}^{2}$ in each of the following quadratics
a. $y=1 / 3 x^{2}$
b. $y=-5 x^{2}$
c. $y=-0.001 x^{2}$
$\qquad$

## Parabola Investigation \#2


2. State the transformations performed on $\mathrm{y}=\mathrm{x}^{2}$ in each of the following quadratics
a. $y=2 x^{2}-9$
b. $y=-0.5 x^{2}-16$
c. $y=-3 x^{2}+9$

## Parabola Investigation \#3


3. State the transformations performed on $\mathrm{y}=\mathrm{x}^{2}$ in each of the following quadratics
a. $y=(x+2)^{2}$
b. $y=(x-4)^{2}-7$
c. $y=-(x+4)^{2}+3$
d. $y=2(x-1)^{2}$
$\qquad$

## Sketching Quadratics using Transformations

1. Summarize what the letters of $y=a(x-h)^{2}+k$ stand for. Make a note on the order that transformations should be applied in.
2. Write an equation of a parabola that satisfies each set of conditions
a.Opens down, congruent with $y=\frac{1}{4} x^{2}$, vertex $(5,-4)$
b. Vertex $(-3,-8)$, $x$-intercepts of 1 and -7 .
c. Vertex $(2,7)$, y-intercept -3 .
d. Vertex $(0,-4)$, passes through $(-3,2)$

Date: $\qquad$ Name:
3. Describe the transformations (in the correct order) applied to the graph of $y=x^{2}$ to obtain the graphs of the following quadratic relations. Sketch the graph by hand. Start with the graph of $y=x^{2}$ and show all transformations with different colours.
a. 9
$y=-3(x+2)^{2}+8$
b.
$y=0.5 x^{2}-9$
c.

$$
y=-1.5(x-5)^{2}
$$


4. Determine the combination of transformations that would result in the following graphs, then determine a possible equation for the graph.
a. 40

b. 8

C.


Date: $\qquad$

## Domain and Range

Some of the questions in the textbook require you to graph with technology. There are lots of applets you can use online, or you can download a free program to use on your computer offline.

Online Graphing Calculator
http://my.hrw.com/math06 07/nsmedia/tools/Graph Calculator/graphCalc.html

## Download GeoGebra (offline and online)

http://www.geogebra.org/cms/en/download, select webstart, for offline select appletstart, for online

1. Use graphing software to graph each function and then use the graph to state the domain and range.
a. $f(x)=2(x+3)^{2}-8$
b. $g(x)=4-2 x-0.25 x^{2}$
2. Notice that range is visible from ONE of the versions of quadratic equation above. What must the equation look like for range to be visible and how can you determine the range from it?
3. What is the domain and range for lines? (make sure you explain all types of possible lines)
4. Find the domain and range for each of the following ralations.
a. $f(x)=-3 x^{2}+5$
b. $g(x)=5$
c. $x=-6$
d. $h(x)=4(x+3)^{2}$
e. $f(x)=7 x-3$
f. $g(x)=-(x-5)^{2}+8$
g. $f(x)=x^{2}+5 x-3$

Date: Name: $\qquad$
5. While on vacation, Talisha won a lot of tickets at two arcades on the boardwalk she was visiting. The first arcade charges $\$ 1$ to cash in and gives you 12 cents back on each ticket won, the second arcade gives you 10 cents back on each ticket and no fee to cash in.
a. Determine the equations for the money you can leave with as functions of winning tickets for both arcades.
b. Determine the domain and range for both arcades.
6. A rocket is launched and its height in feet as a function of time in seconds is given by $1600 t-16 t^{2}$. Find the domain and range that will make sense in the context of this real life situation. (use a table of values)
7. Oberon Cell Phone Company advertises servise for 3 cents per minute plus a monthly cost of $\$ 29.95$.
a. Determine the equation for the cost as a function of minutes.
b. Determine the domain and range for this real life situation.
8. Two people are playing golf. The height above the ground in meters is given by $h_{1}(t)=-5 t^{2}+40 t$ for a person hitting the golf ball from ground level and $h_{2}(t)=-5 t^{2}+40$ for a person hitting the golf ball from a roof of a building.
a. For which player must you create a table of values to see domain and range? Create it. (if you took grade 10 academic course, you may: for the RANGE -complete the square to see vertex, and for the DOMAIN - common factor to see zeros instead of doing the table of values - if you remember how)
b. Find the domain and range for both players.

