GRADE 11 MATH

TABLE OF CONTENTS

GRADE 11 MATH

IN-SCHOOL PREPARATION

TEACHER'S NOTE

MEETING THE EXPECTATIONS

BEFORE THE PARK

TEACHER’S NOTE

Welcome Grade 11 Teachers to
Canada’s Wonderland’s Math Program!

We have provided you with activities that will take you from your classroom to an action filled day at the Park. The **BEFORE THE PARK** activities are set up for your students to practice some new skills and review some old ones before they go to the Park. The **AT THE PARK** activities are a continuation and extension of the classroom activities. The tasks set up for your students at the Park are designed to let them enjoy all that Canada’s Wonderland has to offer, while gathering some data to be used back at the school. The students will use this information to complete a **SUMMATIVE ASSESSMENT** that allows them to extend the experiences that they began in the classroom before the trip. Every activity is completely linked to the new revised Mathematics Curriculum.

Every activity is designed as a real-world experience. As in the real world, there are many possible solutions to a variety of questions. We encourage you to challenge your students to think deeply and reflect on the tasks that are set out before them. We hope that this experience will be a celebration and extension of your teaching and learning this year.

Thank you for your on-going support for young people and our programs at Canada’s Wonderland.

MEETING THE EXPECTATIONS

Mathematics Grade 11

A correlation with the Ontario Mathematics Curriculum, Gr. 11 Functions

ACTIVITY	EXPECTATIONS
Consider Your Options	- explain the meaning of the term *function* and distinguish a function from a relation that is not a function - explain the meanings of the terms *domain* and *range*, through investigation using numeric, graphical, and algebraic representations of the functions - represent linear and quadratic functions using function notation, given their equations or tables of values - solve problems involving quadratic functions arising from real-world applications and represented using function notation
Step Right Up	- explain the meaning of the term *function* and distinguish a function from a relation that is not a function - represent linear and quadratic functions using function notation, given their equations or tables of values - relate the process of determining the inverse of a function to their understanding of reverse processes - determine the numeric or graphical representation of the inverse of a linear or quadratic function, given the numeric, graphical, or algebraic representation of the function - solve problems involving quadratic functions arising from real-world applications and represented using function notation

MEETING THE EXPECTATIONS

ACTIVITY	EXPECTATIONS
Trends	- explain the meaning of the term *function* and distinguish a function from a relation that is not a function - represent linear and quadratic functions using function notation, given their equations or tables of values - determine the numeric or graphical representation of the inverse of a linear or quadratic function, given the numeric, graphical, or algebraic representation of the function - determine, through investigation using technology, the roles of the parameters a, k, d, and c in functions of the form $y = af(k(x - d)) + c$ - determine the number of zeros (i.e. x-intercepts) of a quadratic function - determine the maximum or minimum value of a quadratic function whose equation is given in the form $f(x) = ax^2 + bx + c$ - solve problems involving quadratic functions arising from real-world applications and represented using function notation
Hang Time	- describe key properties (e.g. cycle, amplitude, period) of periodic functions arising from real-world applications - predict, by extrapolating, the future behaviour of a relationship modelled using a numeric or graphical representation of a periodic function - determine, through investigation using technology, the roles of the parameters a, k, d, and c in functions of the form $y = af(k(x - d)) + c$ - sketch graphs of $y = af(k(x - d)) + c$ - collect data that can be modelled as a sinusoidal function - identify periodic and sinusoidal functions, including those that arise from real-world applications involving periodic phenomena - distinguish exponential functions from linear and quadratic functions

MEETING THE EXPECTATIONS

ACTIVITY	EXPECTATIONS
Teen Years Benefits ***(Summative)***	- explain the meaning of the term *function* and distinguish a function from a relation that is not a function - explain the meanings of the terms *domain* and *range*, through investigation using numeric, graphical, and algebraic representations of the functions - represent linear and quadratic functions using function notation, given their equations or tables of values - solve problems involving quadratic functions arising from real-world applications and represented using function notation - determine, through investigation using technology, the roles of the parameters a, k, d, and c in functions of the form $y = af(k(x - d)) + c$ - determine the number of zeros (i.e. x-intercepts) of a quadratic function - determine the maximum or minimum value of a quadratic function whose equation is given in the form $f(x) = ax^2 + bx + c$

Consider Your Options

Your school cafeteria is considering introducing different meal plan options.

Options	Description	Cost
Option 1 - Platinum Meal Plan	5 meals per week for the school year	$ 1200.00
Option 2 - Gold Meal Plan	3 meals per week for the school year	$ 840.00
Option 3 - Silver Meal Plan	2 meals per week for the school year	$ 600.00
Option 4 - Bronze Meal Plan	1 meal per week for the school year	$ 320.00

a) Estimate how many weeks are in a school year and determine the cost of each meal for each option above.

b) Your friend asks you to go out with him for lunch on a school day. You choose to go to the pizza shop close to your school. You spend $5.50 on your lunch. You have the Platinum Meal Plan. What is the actual cost of your lunch? (Don't forget that you have already paid for your meal plan.)

Consider Your Options *(cont'd)*

c) The demand function for Option 1 is given by $P(x) = -3x + 25$ where p is the price in dollars and x is the number of items sold in hundreds. The cost function is $C(x) = 7x + 15$.

i) Find the corresponding revenue function

ii) Find the corresponding profit function

iii) Complete the square to show the maximum profit

iv) How many Option 1 meal plans must be sold for the Cafeteria to break even?

Step Right Up

NOTE This activity is for the purpose of this program and do not accurately reflect operational procedures or plans for Canada's Wonderland.

The management at Canada's Wonderland has noted that the sale of individual one day pay-as-you-go tickets can be increased by offering discount ticket prices. The table records a range of discounts and the corresponding visitors.

Cost $	$ 47.99	$ 43.99	$ 37.99	$ 29.49	$ 24.40
Number of Additional Visitors	800	1800	3000	3750	5000

a) Use a graphing calculator to create a scatter plot for this relationship

b) Find the equation of the line of best fit for this relationship. Write this relationship in function notation.

c) On your graphing calculator plot the inverse relation. Find the equation of the line of best fit for the inverse relation. Write this relationship in function notation.

d) Using your results above estimate the number of additional visitors to the park if the cost of a ticket was $49.99.

e) Estimate the price that Canada's Wonderland should charge per discounted ticket if it wishes to have an additional 8000 people at the park.

Trends

NOTE This activity is for the purpose of this program and do not accurately reflect operational procedures or plans for Canada's Wonderland.

The annual attendance at Canada's Wonderland for the past ten years is shown below:

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Annual attendance (in hundred thousands)	20.4	22.8	23.7	26.1	24.6	23.2	24.1	21.5	25.7	26.3

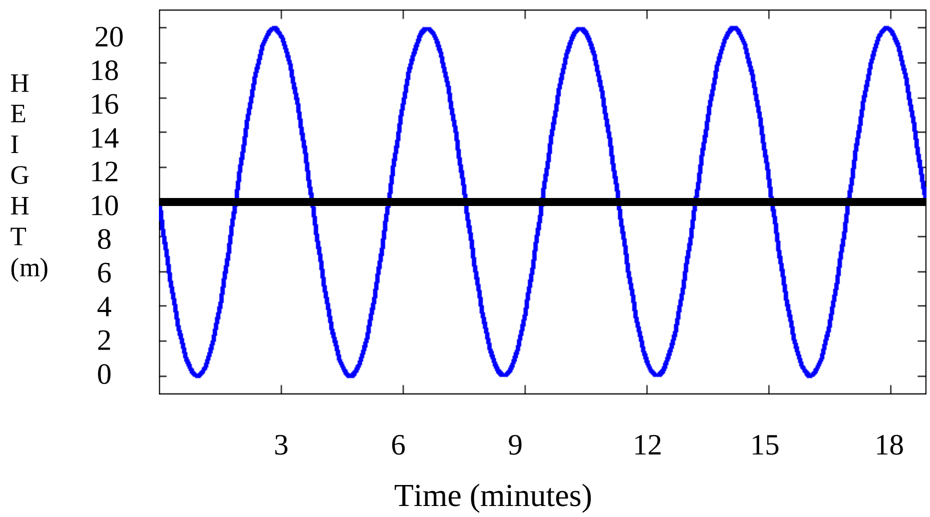
1. Use your graphing calculator to determine what polynomial function can be used to model these data? (*Use 1 through 10 for the Year rather than 1999 through 2008*)

2. Use the model to predict the annual attendance in 2011. (*This is year 13.*)

3. Use the model to predict when the annual attendance will rise or drop to 19 hundred thousand.

Hang Time

Paul is riding a Ferris Wheel and the graph shows his height above ground as a function of time.



1. What is Paul's maximum and minimum height above the ground?

   Max: ___________ Min: ___________

2. What is the amplitude of the graph and how does this relate to Paul's height above the ground?

3. What is the time interval for one complete rotation of the Ferris Wheel?

GRADE 11 MATH

AMUSEMENT RIDE ACTIVITIES

AT THE PARK

SUMMATIVE ASSESSMENT

Consider Your Options

NOTE This activity is for the purpose of this program and do not accurately reflect operational procedures or plans for Canada's Wonderland.

Canada's Wonderland wants to create a season pass purchase plan geared toward students in Ontario to ensure that students will get the best value for their money. Collect the following data from the signs outside the Main Entrance.

Options	Description	Purchase Price
Option 1 - Season Pass 4 or More	A minimum of 4 season passes must be purchased	
Option 2 - Individual Season Pass	For guests who would like to purchase passes individually	
Option 3 – Pay as You Go	For guests who would like to pay general admission	

a) You and 3 friends plan to visit the Park 3 times this season. Would Option 1, Option 2, or Option 3 be the best value? Show why you know that this is the best option.

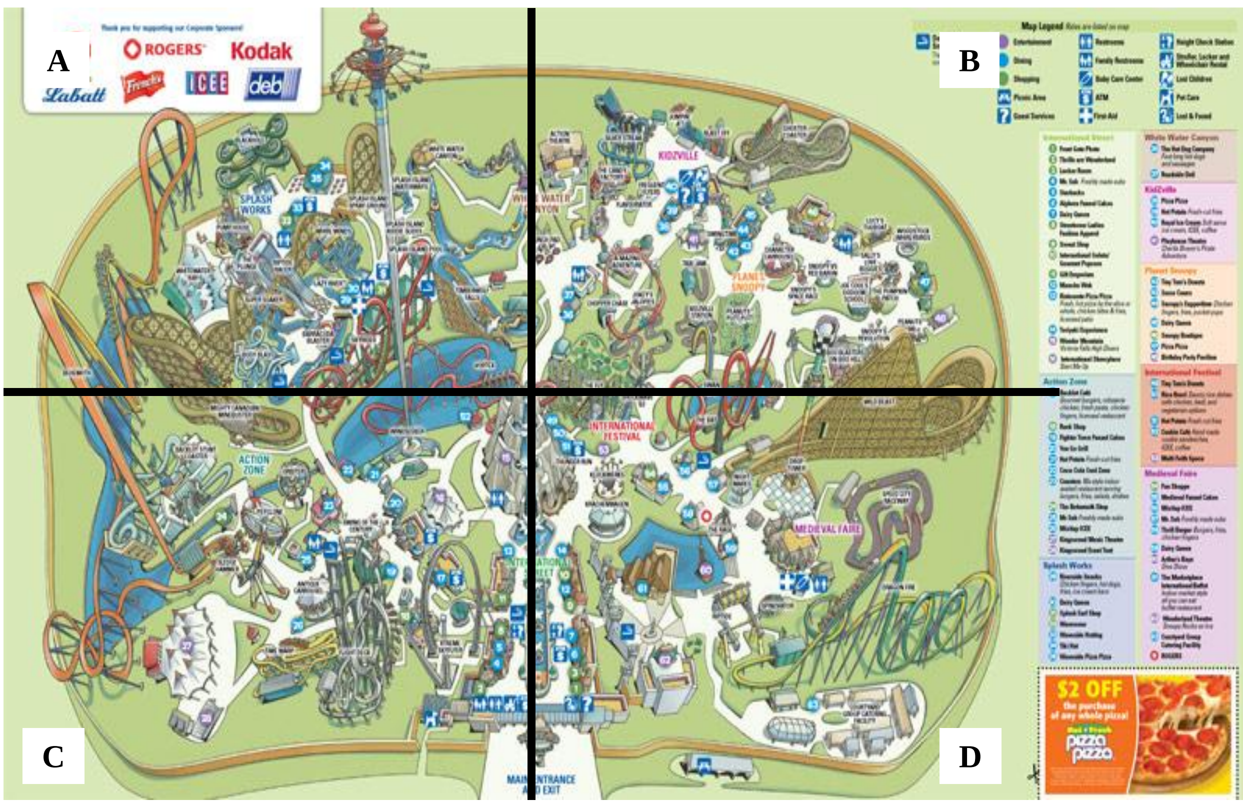
b) You and a friend visit the Park 3 times this season. Would your choice of option now change from question (a)? Show why.

c) Explain why these options are functions. State a reasonable domain and range for these options.

Step Right Up

Does the number of passengers that will fit on a ride have an effect on the size of the ride's line-up?

1. As you move through the Park today, choose 4 different rides from the following 4 zones in the Park and fill out the table. Make a reasonable estimate of the number of passengers waiting in line.



Ride	Number of passengers that fit on the ride	Number of passengers waiting for the ride
ZONE A -		
ZONE B -		
ZONE C -		
ZONE D -		

2. Construct a scatter plot of the number of riders per ride versus the number of passengers waiting in line.

3. What relationship seems to exist between number of riders that fit in a ride and number of passengers waiting?

4. Create a plot showing the inverse relationship of these data. Use the space at the right for any rough work.

5. Use this model to estimate the number of people in line if a ride could hold 50 passengers.

Trends

Does the height of the first drop of a roller coaster depend on its age?

1. Find the sign indicating the horizontal distance to the first drop for 5 roller coasters.

2. Use your horizontal accelerometer at these points to find the heights of the first drop. Follow the instructions below:

   - Since the normal operation of the ride cannot be interfered with, measurements of distances directly in the ride area are ***absolutely not allowed***. For safety reasons, measurements of heights, distances and diameters can be estimated remotely by using the following method: *measuring height by triangulation*.

   - A horizontal accelerometer can be used for this. Suppose the height, *h*, of a ride must be determined. First the distance, *L*, is given at the Park. Sight along the accelerometer to the top of the ride and read the angle θ. Add in the height of your eye to get the total height.

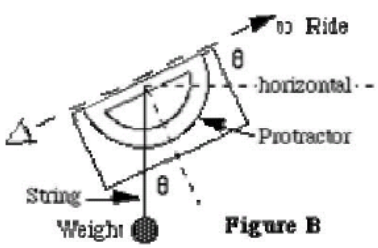


Figure B

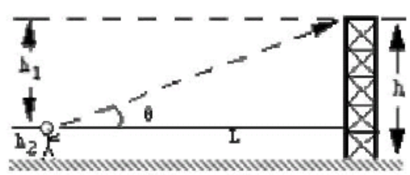


Figure B:

$\tan\theta = h_1 / L$, $h_1 = L \tan\theta$; h_2 = height of eye from ground; h = total height of ride = $h_1 + h_2$

RIDE	YEAR OPENED	HEIGHT OF FIRST DROP
Mighty Canadian Minebuster	1981	
Skyrider	1984	
Vortex	1991	
The Fly	1999	
Behemoth	2008	

3. Plot a graph of the height of the first drop versus the age of the ride. Draw a smooth curve of best fit.

4. Does a relationship seem to exist between the height of the first drop and the age of the ride?

5. Take these data back to school with you and using a graphing calculator, determine what polynomial function could be used to model these data. (*Represent 1981 as year 1.*)

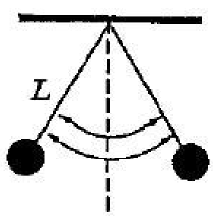
6. Use this model to predict the height of the first drop of a ride that is introduced to the Park in 2012.

Hang Time

We live in a world of periodic and chaotic motion. The human heart beats with a periodic rhythm. Earth travels in an elliptical orbit around the sun with a period about equal to 365 days. As you will see, the amusement park is a small world filled with periodic motions. Did you know that even the sound waves that produce the Park's music are periodic?

A point moves in *periodic motion* if there is a fixed amount of time, *T*, over which the point traverses the same path again and again. The time, *T*, is called the period of the motion. One repetition of the motion is called a *cycle*.

1. The diagram at the left shows a pendulum bob on a rod of length L. When L is given as a number of metres, the formula gives the period T in seconds.



Exercises 1–2

$$T = 2\pi\sqrt{\frac{L}{9.78}}$$

a) Find T when L = 42.6 cm ______s

Notice that 9.78 is close to π^2. If we substitute π^2 for 9.78 in the formula, the formula becomes $T = 2\sqrt{L}$. Your answer to part a) should be close to $2\sqrt{L}$.

b) Find L when T = 8 s. _______m

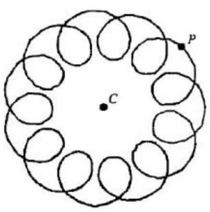
2. Refer to Exercise 1. Use a table or graph to analyze how T changes as L increases. Does T double if L is doubled?

3. **Gathering Data:** Locate and observe a ride that you believe involves periodic motion.

   a) Find the period of the ride. _________ s

   b) Find the number of cycles in one run. _________ cycles

4. The diagram at the left shows a point P looping around a central point C in a pattern.



   a) **Gathering Data**: Try to locate a ride that has a point moving in the way shown. (The ride will not necessarily have the same number of loops.)

   b) Estimate the period of the ride, if there is one. ____________s.

5. **Gathering Data**: Locate and observe a ride that you believe does not involve periodic motion. Explain why you think there is no period.

NOTE This activity is for the purpose of this program and do not accurately reflect operational procedures or plans for Canada's Wonderland.

6. A roller coaster called the Stomach Inverter is to be designed for Canada's Wonderland. The path of the roller coaster will be modelled by a sinusoidal curve. Enter and graph the following in your graphing calculators:

   A. $y = \cos x$

   B. $y = \cos 2x$

   C. $y = 3 \cos 2 (x - \pi/2)$

   D. $y = 3 \cos 2x + 4$

   E. $y = 3 \cos 2 (x - \pi/2) + 4$

   a) Which of the above equations would you choose as a model for the path of a roller coaster? Why?

   b) Write a descriptive paragraph using mathematical vocabulary, such as amplitude, period, phase shift, and vertical shift to justify your selection.

Teen Years Benefits

Through observing trends over the past 20 years Canada's Wonderland has determined that teenagers are their most devoted and loyal customers. Kate, a top notch high school intern in the Group Sales Department, has stumbled across a memo containing Park trends data. Kate is determined to turn this internship into a full time job when she finishes her schooling. She has come up with the concept of "Teen Years" Benefits that favour teenage patrons of the Park. Kate needs your help to statistically prove that her ideas will work.

NOTE These Summative Assessment activities are for the purpose of this program and do not accurately reflect costs, operational procedures or plans for Canada's Wonderland.

Teen Years Benefits – *The Calculations*

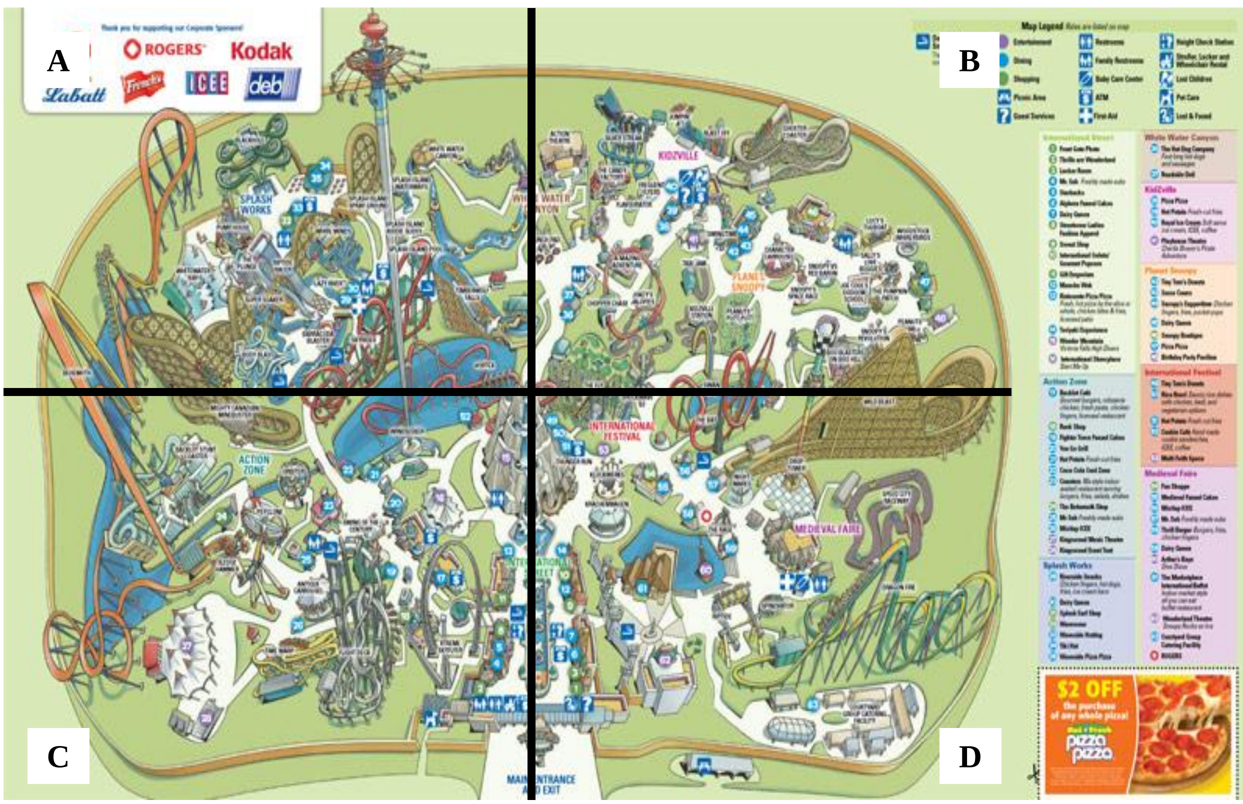
Kate's first big idea is an all inclusive convenience pass that will allow teens to come to the Park throughout the season without bringing extra pocket change.

OPTIONS	PRICE	FEATURES
A	$150	1 Season Pass 5 Food Vouchers (valued at $10 each) 7 Free Game Vouchers (valued at $3 each)
B	$200	1 Season Pass 9 Food Vouchers (valued at $10 each) 10 Free Game Vouchers (valued at $3 each)
C	$220	1 Season Pass 10 Food Vouchers (valued at $10 each) 15 Free Game Vouchers (valued at $3 each)

1. a) Which is the best option for teens planning to visit the Park throughout the season? Show your work.

1. b) Based on the data that she gathers from the memo, Kate estimates that 1000 teens will purchase Option C in a given season. She is also considering raising the cost of Option C by $10; however, in doing so she assumes that 100 fewer teens will purchase Option C. What should Kate charge for Option C to maximize the revenue for the Park?

2. Kate would also like to provide a fast pass option for teens. The teen fast pass allows teen riders to go into a faster moving second lane. Kate believes that Wonderland could better utilize less busy areas of the Park with a limited fast pass system. Based on the data that you gathered in the **STEP RIGHT UP** section, answer the following questions:



a) Which area of the Park seems to have the smallest cluster of patrons?

b) Which rides would you offer a fast pass for in this area?

c) A roller coaster carried 30 000 passengers last year in total. Kate proposes that by having a teen fast pass lane on this ride, an additional 2000 students would ride it per year. Write an equation that represents the number of total riders over time, starting from last year. Define any variables used.

d) Using the equation that you developed, determine the total number of riders on this ride 8 years from now.

3. Kate would like to propose that Canada's Wonderland designate a substantial advertising budget for a certain segment of the teen market. She needs you to analyze the data below on rider trends, and make a suggestion as to which teen segment would be best to cater to.

Use the data provided below to help with your decision;

Age (x)	**13**	**14**	**15**	**16**	**17**	**18**	**19**
Total # of Riders / Season in Thousands (y)	**2.2**	**3.5**	**6.3**	**10.7**	**9.8**	**7.5**	**5.2**

a) Use quadratic regression on a graphing calculator to estimate y as a function of x.

b) Based on your regression what is the optimal age?

c) With this optimal age, what is the expected number of this group?