Name _____   Date_____

Lesson 1: Analyzing a Graph

Exit Ticket

Read the problem description and answer the questions below. Use a separate piece of paper if needed.

A library posted a graph in its display case to illustrate the relationship between the fee for any given late day for a borrowed book and the total number of days the book is overdue. The graph, shown below, includes a few data points for reference. Rikki has forgotten this policy and wants to know what her fine would be for a given number of late days.

[Note: The ordered pairs may be difficult to read. They are: $(1, 0.1)$ $(10, 1)$ and $(11, 1.5)$ $(14, 3)$.]

1. What type of function is this?

2. What is the general form of the parent function(s) of this graph?

3. What equations would you expect to use to model this context?
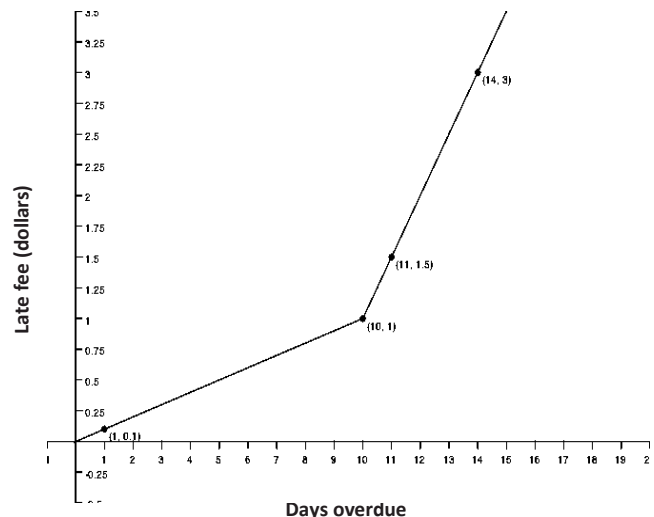
4. Describe verbally what this graph is telling you about the library fees.

5. Compare the advantages and disadvantages of the graph versus the equation as a model for this relationship. What would be the advantage of using a verbal description in this context? How might you use a table of values?

6. What suggestions would you make to the library for how they could better share this information with their customers? Comment on the accuracy and helpfulness of this graph.

Name _____   Date_____

Lesson 2: Analyzing a Data Set

Exit Ticket

Analyze these data sets, recognizing the unique pattern and key feature(s) for each relationship. Then use your findings to fill in the missing data, match to the correct function from the list on the right, and describe the key feature(s) that helped you choose the function.

Table A

x	y
0	6
1	10
2	14
3	◯
4	22
5	◯

Table B

x	y
0	6
1	15
2	18
3	15
4	◯
5	◯

Table C

x	y
−1	$\frac{1}{6}$
0	1
1	◯
2	36
3	◯
4	1296

Table D

x	y
−1	◯
0	6
1	8
2	6
3	0
4	◯
5	−24

Equations:

$f(x) = 6^x$

$h(x) = -3(x-2)^2 + 18$

$g(x) = -2(x+1)(x-3)$

$r(x) = 4x + 6$

Table A: _____ Key Feature(s): _____

Table B: _____ Key Feature(s): _____

Table C: _____ Key Feature(s): _____

Table D: _____ Key Feature(s): _____

Name _____ Date_____

Lesson 3: Analyzing a Verbal Description

Exit Ticket

Create a model to compare these two texting plans:

    i.   Plan A costs $15 a month, including 200 free texts. After 200, they cost $0.15 each.

    ii.   Plan B costs $20 a month, including 250 free texts. After 250, they cost $0.10 each.

Name _____ Date_____

Lesson 4: Modeling a Context from a Graph

Exit Ticket

1. Why might we want to represent a graph of a function in analytical form?

2. Why might we want to represent a graph as a table of values?

Name _____   Date_____

Lesson 5: Modeling From a Sequence

Exit Ticket

1. A culture of bacteria doubles every 2 hours.

    a.   Explain how this situation can be modeled with a sequence.

    b.   If there are 500 bacteria at the beginning, how many bacteria will there be after 24 hours?

Name _____   Date_____

Lesson 6: Modeling a Context From Data

Exit Ticket

1. Lewis' dad put 1,000 dollars in a money market fund with a fixed interest rate when he was 16. Lewis can't touch the money until he is 26, but he gets updates on the balance of his account.

Years After Lewis Turns 16	Account Balance in Dollars
0	1000
1	1100
2	1210
3	1331
4	1464

a. Develop a model for this situation.

b. Use your model to determine how much Lewis will have when he turns 26 years old.

c. Comment on the limitations/validity of your model.

Name _____   Date_____

Lesson 7: Modeling a Context From Data

Exit Ticket

1. Use the following data table to construct a regression model, then answer the questions:

Shoe Length (inches)	Height (inches)
11.4	68
11.6	67
11.8	65
11.8	71
12.2	69
12.2	69
12.2	71
12.6	72
12.6	74
12.8	70

   a. What is the best regression model for the data?

   b. Based on your regression model, what height would you expect a person with a shoe length of 13.4 inches to be?

   c. Interpret the value of your correlation coefficient in the context of the problem.

Name _____   Date_____

Lesson 8: Modeling a Context From a Verbal Description

Exit Ticket

Answer the following question. Look back at this (or other) lessons if you need help with the business formulas.

Jerry and Carlos each have $1000 and are trying to increase their savings. Jerry will keep his money at home and add $50 per month from his part time job. Carlos will put his money in a bank account that earns a 4% yearly interest rate, compounded monthly. Who has a better plan for increasing his savings?
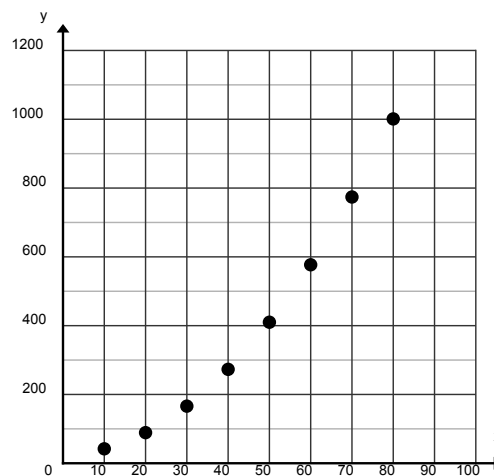
Name _____ Date_____

Lesson 9: Modeling a Context From a Verbal Description

Exit Ticket

The distance a car travels before coming to a stop once a driver hits the brakes is related to the speed of the car when the brakes were applied. The graph of f (shown below) is a model of the stopping distance (in feet) of a car traveling at different speeds (in miles per hour).

1. One data point on the graph of f appears to be (80,1000). What do you think this point represents in the context of this problem. Explain your reasoning.

2. Estimate the stopping distance of the car if the driver is traveling at 65 mph when she hits the brakes. Explain how you got your answer.

3. Estimate the average rate of change of f between $x = 50$ and $x = 60$. What is the meaning of the rate of change in the context of this problem?

4. What information would help you make a better prediction about stopping distance and average rate of change for this situation?

Name _____   Date _____

1. In their entrepreneurship class, students are given two options for ways to earn a commission selling cookies. For both options, students will be paid according to the number of boxes they are able to sell, with commissions being paid only after all sales have ended. Students must commit to one commission option before they begin selling.

    Option 1: The commission for each box of cookies sold is 2 dollars.
    Option 2: The commission will be based on the total number of boxes of cookies sold as follows: 2 cents is the total commission if one box is sold, 4 cents is the commission if two boxes are sold, 8 cents if three boxes are sold, and so on, doubling the amount for each additional box sold. (This option is based upon the total number of boxes sold and is paid on the total, not each individual box.)

    a. Define the variables and write function equations to model each option. Describe the domain for each function.

    b. If Barbara thinks she can sell five boxes of cookies, should she choose Option 1 or 2?

    c. Which option should she choose if she thinks she can sell ten boxes? Explain.

d. How many boxes of cookies would a student have to sell before Option 2 pays more than Option 1? Show your work and verify your answer graphically.
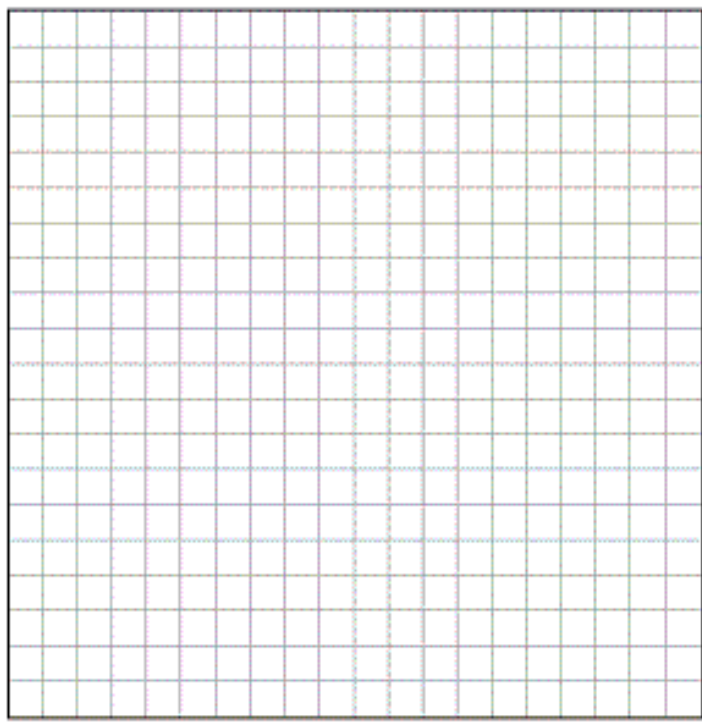
2. The table shows the average sale price p of a house in New York City, for various years t since 1960.

Years since 1960, t	0	1	2	3	4	5	6
Average sale price (in thousands of dollars), p	45	36	29	24	21	20	21

a. What type of function most appropriately represents this set of data? Explain your reasoning.

b. In what year is the price at the lowest? Explain how you know.

c. Write a function to represent the data. Show your work.

d. Can this function ever be equal to zero? Explain why or why not.

e. Mr. Samuels bought his house in New York City in 1970. If the trend continued, how much was he likely to have paid? Explain and provide mathematical evidence to support your answer.

3. Veronica's physics class is analyzing the speed of a dropped object just before it hits the ground when it's dropped from different heights. They are comparing the final velocity, in feet/second, versus the height, in feet, from which the object was dropped. The class comes up with the following graph.

    a. Use transformations of the parent function, $f(x) = \sqrt{x}$, to write an algebraic equation that represents this graph. Describe the domain in terms of the context.


x Height (in feet)
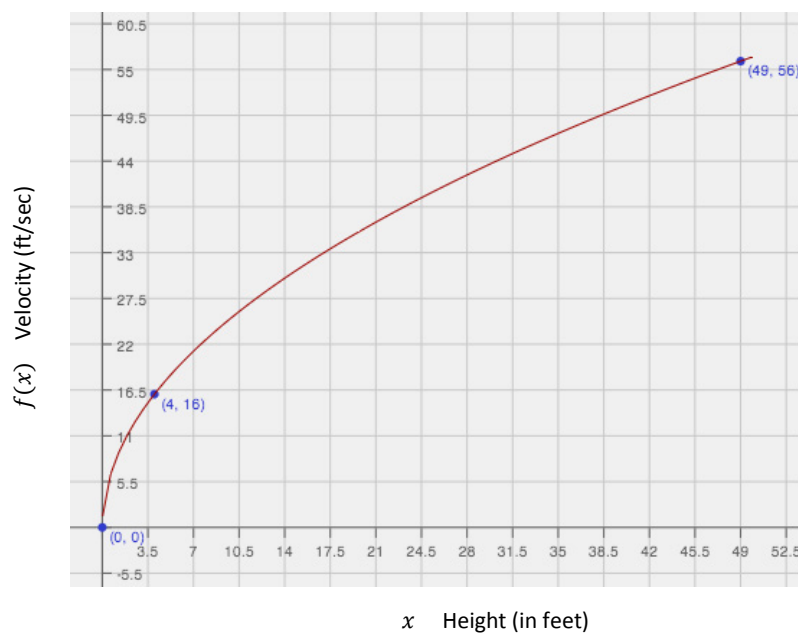
b. Veronica and her friends are planning to go cliff diving at the end of the school year. If she dives from a position that is 165 ft. above the water, at what velocity will her body be moving right before she enters the water? Show your work and explain the level of precision you chose for your answer.

c. Veronica's friend, Patrick, thinks that if she were able to dive from a 330-ft. position, she would experience a velocity that is twice as fast. Is he correct? Explain why or why not.

4. Suppose that Peculiar Purples and Outrageous Oranges are two different and unusual types of bacteria. Both types multiply through a mechanism in which each single bacterial cell splits into four. However, they split at different rates: Peculiar Purples split every 12 minutes, while Outrageous Oranges split every 10 minutes.

    a. If the multiplication rate remains constant throughout the hour and we start with three bacterial cells of each, after one hour, how many bacterial cells will there be of each type? Show your work and explain your answer.

    b. If the multiplication rate remains constant for two hours, which type of bacteria is more abundant? What is the difference between the numbers of the two bacterial types after two hours?

    c. Write a function to model the growth of Peculiar Purples and explain what the variable and parameters represent in the context.

d. Use your model from part (c) to determine how many Peculiar Purples there will be after three splits, i.e., at time 36 minutes. Do you believe your model has made an accurate prediction? Why or why not?

e. Write an expression to represent a different type of bacterial growth with an unknown initial quantity but in which each cell splits into 2 at each interval of time.

5. In a study of the activities of dolphins, a marine biologist made a slow-motion video of a dolphin swimming and jumping in the ocean with a specially equipped camera that recorded the dolphin's position with respect to the slow-motion time in seconds. Below is a piecewise quadratic graph, made from the slow-motion dolphin video, which represents a dolphin's vertical height (in feet, from the surface of the water) while swimming and jumping in the ocean, with respect to the slow-motion time (in seconds). Use the graph to answer the questions. [Note: The numbers in this graph are not necessarily real numbers from an actual dolphin in the ocean.]

Time in seconds
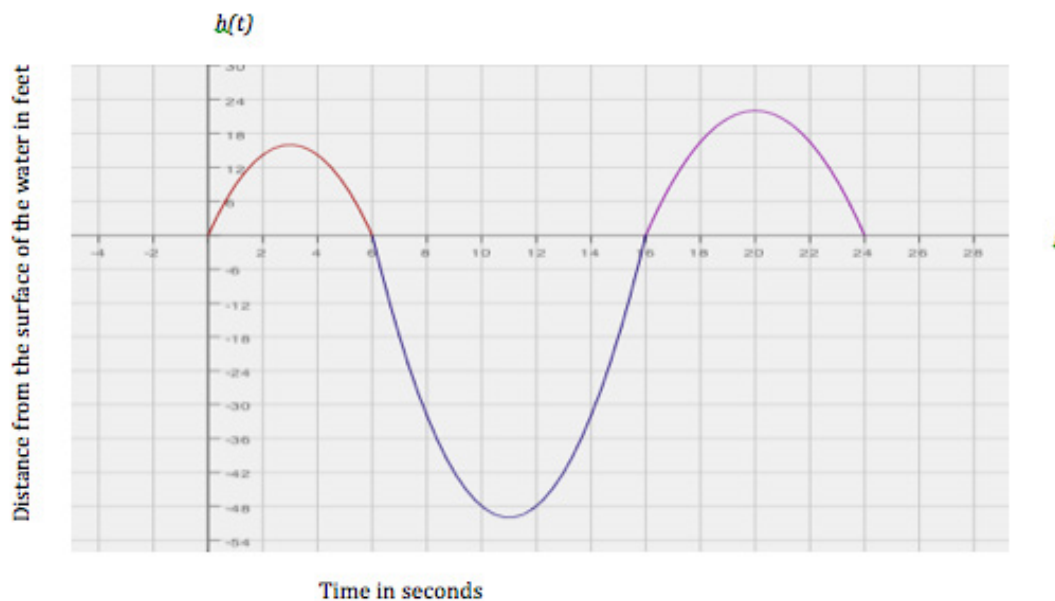
a. Given the vertex $(11, -50)$, write a function to represent the piece of the graph where the dolphin is underwater. Identify your variables and define the domain and range for your function.

b. Calculate the average rate of change for the interval from 6 to 8 seconds. Show your work and explain what your answer means in the context of this problem.

c. Calculate the average rate of change for the interval from 14 to 16 seconds. Show your work and explain what your answer means in the context of this problem.

d. Compare your answers for parts (b) and (c). Explain why the rates of change are different in the context of the problem.

6. The tables below represent values for two functions, *f* and *g*, one absolute value and one quadratic.

    a. Label each function as either <u>absolute value</u> or <u>quadratic</u>. Then explain mathematically how you identified each type of function.
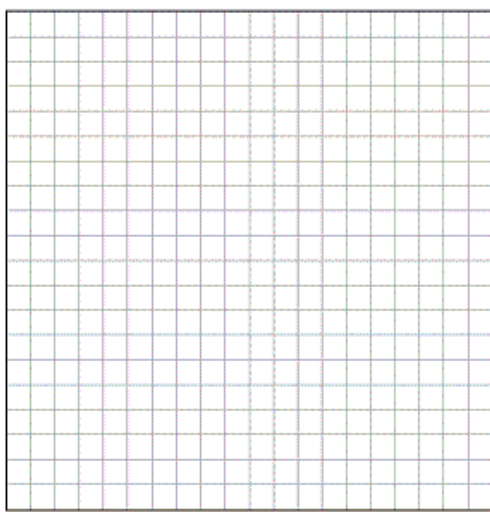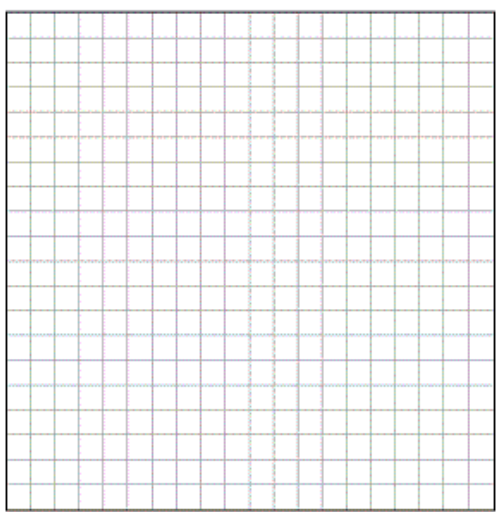
$f(x)$: _____

x	$f(x)$
-3	1.5
-2	1
-1	0.5
0	0
1	0.5
2	1
3	1.5

$g(x)$: _____

x	$g(x)$
-3	4.5
-2	2
-1	0.5
0	0
1	0.5
2	2
3	4.5

    b. Represent each function graphically. Identify and label the key features of each in your graph (e.g., vertex, intercepts, axis of symmetry, etc.).

c.   Represent each function algebraically.

7. Wendy won a one million dollar lottery! She will receive her winnings over the course of 10 years, which means she will get a check for $100,000 each year. In her college economics class, she learned about inflation, a general percentage increase in prices and fall in the purchasing power of money over time. (This is why prices from the past are sometimes referred to as "adjusted for inflation.") The inflation rate varies; from 2003 to 2013 the average rate has been 2.36% per year. This means that the value of a fixed dollar amount has decreased by 2.36%, on average, per year.

a. Wendy wants to make sure she gets the most out of her winnings, so she wants to figure out how much purchasing power she will lose over the course of the 10 years. Assume the average inflation rate will remain the same for the next 10 years. Complete the table below to help her calculate her losses in purchasing power due to inflation.

Year	Check Amount	Purchasing Power After Adjusted for Inflation	Loss in Purchasing Power
0	100,000.00	100,000.00	0.00
1	100,000.00	97,640.00	2,360.00
2	100,000.00		
3	100,000.00		
4	100,000.00		
5	100,000.00		
6	100,000.00		
7	100,000.00		
8	100,000.00		
9	100,000.00		
10	100,000.00		

b. The far right column shows the estimated loss in purchasing power for each year based on 2.36% inflation. Wendy would like to know what her total loss in purchasing power will likely be. Taking into account that inflation varies each year and 2.36% represents the average inflation rate over a period of years, report an answer to Wendy. What will her total estimated loss be? Choose an appropriate level of accuracy and show or explain how you got your answer.

c. James wrote the following equation to model this context: $P(t) = -2123.06t + 99612.56$. Tiah wrote the equation: $Q(t) = 100{,}000(0.9764^t)$. Which is a better model? Explain why.

d. Wendy decides to try to offset the effects of inflation by investing $50,000, from her first check only, in a mutual fund with an annual 5% return. If she lets this money grow (i.e., she makes no deposits or withdrawals) for 10 years, will she make up the loss in purchasing power over the full 10 years?