Buying A Car

I. UNIT OVERVIEW & PURPOSE:

In this lesson the student will be asked to search the Internet and find a car that he/she would like to purchase. The student will decide on a down payment and calculate the monthly payment (without interest). He/she will then transform the graph to determine how changing the down payment or changing the monthly payment will affect the life of the loan.

II. UNIT AUTHOR:

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III. COURSE:

Mathematical Modeling: Capstone Course (the course title might change)

IV. CONTENT STRAND:

Algebra

V. OBJECTIVES:

The student will use knowledge of transformations to write an equation, given the graph of a function (linear, quadratic, exponential, and logarithmic).

VI. MATHEMATICS PERFORMANCE EXPECTATION(s):

The student will use knowledge of transformations to write an equation, given the graph of a function (linear, quadratic, exponential, and logarithmic).

VII. CONTENT:

The student will be asked to search the Internet for a car he/she would like to "purchase" and then will investigate the a simple re-payment of a loan – no interest and no tax.

VIII. REFERENCE/RESOURCE MATERIALS:

Resources for the search will be up to the students. There is an article the student is expected to read and the address is in the lesson.

IX. PRIMARY ASSESSMENT STRATEGIES:

Assessment will consist of a journal entry (reflective in nature) and assessment questions.

X. EVALUATION CRITERIA:

A "key" is provided for the final assessment. Students should be graded on their understand of the concept and the correctness of the answer to the questions.

XI. INSTRUCTIONAL TIME:

Three – 45 minute class periods plus time for the assessment

Lesson 1 Buying A Car

Strand
Algebra and Functions

Mathematical Objective(s)
The goal of this lesson is to payback the purchase of a vehicle. Students will be asked to compare simple payback structures of various down payments and monthly payments on the repayment of the cost of the vehicle. The student will make one calculation using down payment as the y-intercept and the monthly payment as the constant (or slope). The time will be the independent variable.

Mathematics Performance Expectation(s)
The student will use knowledge of transformations to write an equation, given the graph of a function (linear, quadratic, exponential, and logarithmic).

Related SOL

A.7 The student will investigate and analyze function (linear and quadratic) families and their

b) domain and range;
c) zeros of a function;
d) *x*- and *y*-intercepts;
e) finding the values of a function for elements in its domain; and
f) making connections between and among multiple representations of functions including concrete, verbal, numeric, graphic, and algebraic.

AII.6 The student will recognize the general shape of function (absolute value, square root, cube root, rational, polynomial, exponential, and logarithmic) families and will convert between graphic and symbolic forms of functions. A transformational approach to graphing will be employed. Graphing calculators will be used as a tool to investigate the shapes and behaviors of these functions.

AFDA.2 The student will use knowledge of transformations to write an equation, given the graph of a function (linear, quadratic, exponential, and logarithmic).

AFDA.3 The student will collect data and generate an equation for the curve (linear, quadratic, exponential, and logarithmic) of best fit to model real-world problems or applications. Students will use the best fit equation to interpolate function values, make decisions, and justify conclusions with algebraic and/or graphical models.

NCTM Standards

- use graphs to analyze the nature of changes in quantities in linear relationships.
- represent, analyze, and generalize a variety of patterns with tables, graphs, words, and, when possible, symbolic rules;

Additional Objectives for Student Learning (include if relevant; may not be math-related):
Concepts of borrowing money (banking) and planning with a budget

Materials/Resources
- Classroom set of graphing calculators
- Internet access

Assumption of Prior Knowledge
- Be able to graph a linear equation with understanding of the range and domain
- Understand the difference between slope and y-intercept
- Be able to search the internet to find the price and description of a vehicle

Introduction: Setting Up the Mathematical Task

All students are interested in buying his/her own vehicle. In this investigation, the student will be asked to select a vehicle to buy - it can be an antique car or truck, a motorcycle, a used car or truck, or a new car or truck. Of course after the student decided on a vehicle, he or she will need to pay for the vehicle. The assumption will be made that the student will need to borrow money to pay for the vehicle. The student will be able to select a down payment, calculate the monthly payment, and graph the payback. After the graph is established, students will be asked to change the down payment (the y-intercept) or the monthly payment (the slope) and transform the payment line. The intent of this activity is for the student to see the effect of higher or lower down payment or monthly payment and how timely a car loan can be repaid.

Student Exploration 1:

1. Read the article that discusses the top five mistakes when buying a car. (Individual or group activity)
2. Student will search the Internet for a vehicle that he/she would like to purchase.
3. For this activity, there will be no fees to title the car and no tax. Keep in mind that these fees do exist and cannot be ignored.
4. Student will need to decide on his/her down payment. It must be between 2% and 15% of the total price.
5. All students will then find the monthly payment by taking the balance and finding the equal monthly payment for 48 months.

6. Answer the questions on the payment calculation sheet "Just the Facts". The graphing may be done on a calculator and sketched on a graph on the calculation sheet.

Individual Work - See "Just the Facts" This can be filled out on line or on paper.

Whole Class Sharing/Discussion

After Sections C – E:

1. Allow time for the students to describe the vehicle that he/she has chosen to purchase and why was that particular vehicle selected.
2. Use the questions on "Just the FACTS" to guide discussion.

After Section F

1. What does the slope represent and what happens to the problem if the slope changes?
2. Can the slope be positive the way the problem has been presented?
3. How would the problem need to be presented for the slope to be positive?
4. Does the graph make sense in all 4 quadrants, why or why not?
5. What does the y-intercept and the x-intercept represent in this problem?
6. What does the domain represent in this problem?
7. What does the range represent in context of this problem?
8. Why were the dimensions of the window chosen as they were?
9. What has happened if the graph is translated 2 units down?
10. Would it mean if the graph were rotated counterclockwise around the y-intercept?

Student/Teacher Actions:

- Before the lesson, the teacher will need to copy the necessary worksheets or prepare the questions to be answered in a word document to be saved.
- The student should be finding information and use it to answer the questions and graph the results
- The teacher should be walking around the room, talking with the student and answering questions.

Monitoring Student Responses

- students are to communicate their thinking and their new knowledge of slope and y-intercept when paying back a loan;
- students are to communicate how the graph would change if the slope or the y-intercept were changes;
- teacher and/or students are to highlight and clarify the relationship of translation and y-intercept and of rotation and slope;
- teacher should be a presence as the students are doing the investigation
- Summarize the lesson: The discussion of the questions will be the summary of the lesson.

Assessment

- Describe and attach the assessments for each lesson objective.
  - **Written Assessment:** Attached – "Buying A Car Quiz"
  - **Journal/writing prompts – to be written on the board and answered after the investigation**
    - Write what you believe to be the best way to finance the purchase of the vehicle you selected. Explain why. Think about what type of job you would need to have to make the payments you have outlined.
    - How has this activity made you think about the purchase of a vehicle?

Extensions and Connections (for all students)

- Students can purchase a really expensive vehicle (i.e. F350 diesel engine, stretch cab 2011 Ford truck or a brand new Jaguar) and make a presentation to the class with graphs to explain the "best way" to finance this purchase
- Students can included tax and other fees collected at the time of purchase to see how that might affect the graphing of the situation (This can be done in an Excel spreadsheet)
- Students can change the monthly payments pay from 48 months to 36 months or 60 months or 72 months and explain how that would change the graph.

Strategies for Differentiation

- List ideas for addressing needs of a diverse population of students such as:
  - kinesthetic, auditory, or visual learners – This activity addresses many of these types of learner. The students will need to search for a vehicle of his/her desire. Giving the Web-sites where this can be done might be helpful.
  - The directions should be given out loud as well as written. An example might need to be provided for some. ;
  - Students with processing, memory, motor issues – If a student has motor issues that doesn't allow his/her to type, they might be partnered with someone with similar vehicle interests.;

- English language learners (ELLs) – These students may be partnered with another student who can help him/her understand the process. The lesson also may be translated into Spanish or other languages.;
- high-ability students - Students can change the monthly payments pay from 48 months to 36 months or 60 months or 72 months and explain how that would change the graph.

Buying a Car

A. Challenge: Select a car to purchase. Payment for the car will be made through a down payment and monthly payments. Analysis will be made based on changing the graphs by translating based on knowledge of slope and y-intercept.

B. Materials Needed: Graphing calculator, Internet access

C. Background Information: Use the Internet to describe the following terms:

1. Down payment

2. Monthly payment

3. Life of the loan

4. y-intercept

5. Slope

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D. Read the article "Top Five Biggest Mistakes When Buying a Car". List a briefly describe in your own words the 5 biggest mistakes consumers make when buying a car.

http://financialplan.about.com/od/savingmoney/a/newcarmistakes.htm

1.

2.

3.

4.

5.

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T or F based on the article:

_____1. It is "smart" to buy a car for $0 down.

_____2. When considering a vehicle, the cost of the car is the only financial consideration.

_____3. A new car is a wiser investment financially that a 2 year old car.

Discuss the answers to these questions with a partner or the class before proceeding to purchase your vehicle.

E. Search the Internet for the car you will purchase. Keep in mind you should be reasonable with your desires. You can "dream" later on in the activity.

Describe in detail your vehicle and cost. COST: _____

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F. "Just the Facts"- Write a journal entry when this data is completed.

1. Cost of vehicle: _____

2. Down Payment: (between 2% and 15% of the cost)_____

3. Balance Borrowed (#1. - #2) _____

4. Monthly Payment (#3 ÷ 48 months) _____

Complete a table of the payments:

# of months	Balance Owed (Balance Borrowed - # of months * monthly payment)
0	
1	
2	
3	
4	
20	
40	
45	
46	
47	
48	

Example:

Cost of car - $10,000

Down Payment - $1000

Balance Owed - $9000

Monthly Payment - $187.50

For 0 months:

9000 – 0* 187.50 = 9000

For 1 month:

9000 – 1*187.50 = 8812.50

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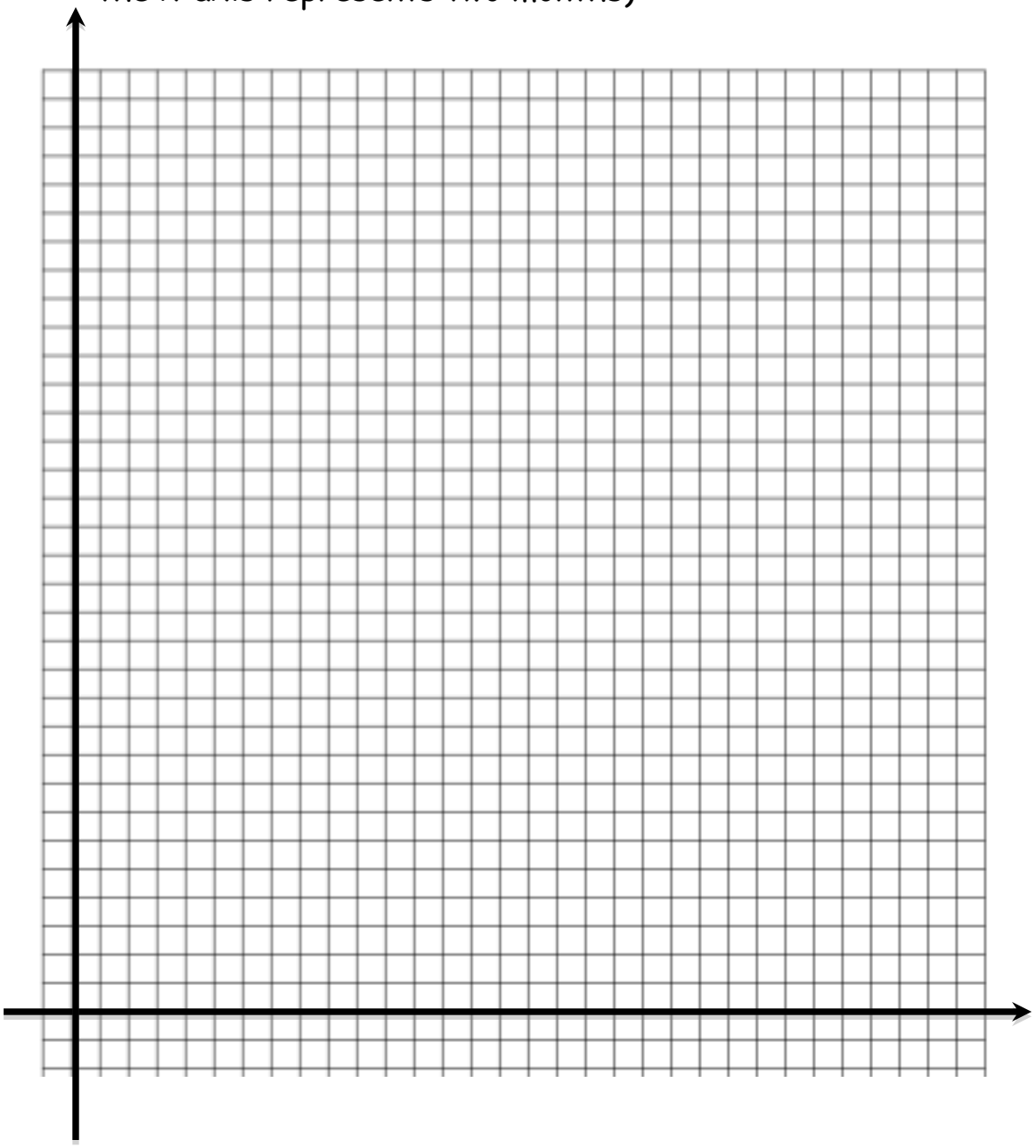
Graph the data from the chart on the previous page. Label the axes and choose an appropriate scale for each axis (example: each square on the x-axis represents two months)



1. Describe the shape of the graph (say more than it is a straight line)

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2. If time in months is the independent variable, what is the dependent variable in the model? _____

3. Write an equation (in the slope-intercept form or in function notation y = mx + b) to represent the situation of buying a car as described in this problem. (Hint: Look at the graph or table to determine the slope and y-intercept)

4. What does the y-intercept represent?

5.What is the slope in the context of this problem?

6. Is the slope positive or negative? Explain in the context of this problem. (Remember slope = $\frac{y_2 - y_1}{x_2 - x_1}$)

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7. Graph the equation written in #3 on your calculator. Adjust the window so the graph (including the x and y intercept) is visible. The scale for the x and y axis will be different so the graph can be viewed. Give the dimensions of the window view:

x- maximum _____	y-maximum _____
x – minimum _____	y- minimum _____
x - scale _____	y – scale _____

Sketches of the graphs should be included when appropriate when answering the questions.

8. What does the x-intercept represent in the context of this problem?

9. If the graph is translated 3 units up, is the monthly payment or the down payment being changed? How does that change the graph and how does that change the outcome of this problem? Graph the new graph with the original graph in your calculaator. Describe what happens to the graph. What type of transformation is this

_____

What is the new equation for this new line (translated 3 units up)?

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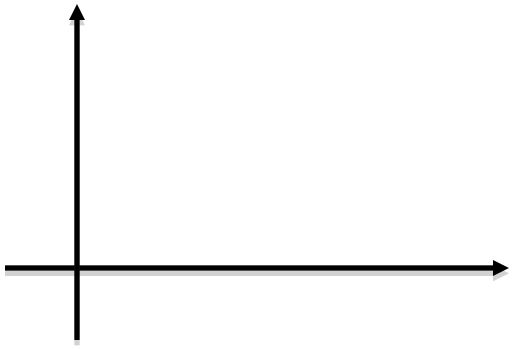
10. Sketch the graph as it now appears on your calculator:



11. If the slope on the original graph is doubled, what happened to the monthly payment and/or the down payment? What type of transformation will represent this change? _____

Write the equation for this new graph. What stays the same and what changes from the original equation?

What is the affect on the outcome of the life of the loan?

11. If the slope of the original graph is cut by 25%, does the monthly payment or the down payment change?

Transformation type? _____

What is the affect on the outcome of the life of the loan?

(Write the journal entry on the board when this data is complete.)

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ASSESSMENT: "Buying A Car"

You are going to buy a 1999 Ford Mustang GT for $4500. You can afford to make a down payment of $250. You will be making 24 payments to pay for this car. Answer the following questions based on your work on "Buying A Car".

1. List 3 of the 5 biggest mistakes consumers make when purchasing a car:

a.

b.

c.

2. What will be the monthly payment for this purchase? _____

(Hint: Use the down payment and repay the amount borrowed over 48 months.)

3. Write an equation in the slope-intercept form to represent this situation.

4. a) If you can afford to pay $250 down payment and $250 a month, how long will it take the loan to be completely paid for?

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b) What is the new equation in slope-intercept form?

5. If your down payment can be $750, how many months will it take you to pay the loan if you pay the same monthly payment calculated in #2? _____

6. What does the slope represent in the formula you used?

7. What does the y-intercept represent in the formula you used?

8. If the original graph is translated down, what has happened in context of the problem? How does the equation change?

9. If the original graph is rotated around the y-intercept, what has happened in context of the problem?

10. What would happen to your graph if tax and fees to title the vehicle were included? Write an equation for this and explain what all of the numbers and variables mean. Assume tax (3%) and fees (1.5%) are paid at one time with the down payment.

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ASSESSMENT: "Buying A Car"- KEY

You are going to buy a 1999 Ford Mustang GT for $4500. You can afford to make a down payment of $250. You will be making 24 payments to pay for this car. Answer the following questions based on your work on "Buying A Car".

1. List 3 of the 5 biggest mistakes consumers make when purchasing a car: (These can be listed from the article.)

a.

b.

c.

2. What will be the monthly payment for this purchase? _(4500 – 250)/24 = $177.08_____

3. Write an equation in the slope-intercept form to represent this situation.

y = 4250 – 177.08x = -177.50x + 4250 b = amount borrowed

x = number of months

4. a) If you can afford to pay $250 down payment and $250 a month, how long will it take the loan to be completely paid for?

0 = 4250 – 250x x = 17 months

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b) What is the new equation in slope-intercept form?

Y = 4250 – 250x = -250x +4250

5. If your down payment can be $750, how many months will it take you to pay the loan if you pay the monthly payment calculated in #2?

_____ 0 = 3750 – 177.08x x = 21.17 months which would mean 22 months but the last payment would not be a full $177.08

6. What does the slope represent in the formula you used? Monthly payment

7. What does the y-intercept represent in the formula you used?

Amount of money borrowed after the down payment

8. If the original graph is translated down, what has happened in context of the problem? How does the equation change? The down payment has increased because the y- intercept (amount owed) is less. The equation would have the same slope but a smaller y-intercept depending on the down payment.

9. If the original graph is rotated around the y-intercept, what has happened in context of the problem? The monthly payment has changed. It has increased or decreased depending on the direction of the rotation or slope.

10. What would happen to your graph if tax and fees to title the vehicle were included? The amount owed (y-intercept) would change. The slope would also change because the initial amount borrowed would be more.

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