Georgia Common Core GPS Coordinate Algebra Supplement: Unit 1
by
David Rennie

Adapted from the Georgia Department of Education Frameworks

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Acting Out

Mathematical Goals

- Model and write an equation in one variable and solve a problem in context.
- Create one-variable linear equations and inequalities from contextual situations.
- Represent constraints with inequalities.
- Solve word problems where quantities are given in different units that must be converted to understand the problem.

Common Core State Standards

- **MCC9-12.A.CED.1**: Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.

- **MCC9-12.A.CED.3**: Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context.

- **MCC9-12.N.Q.1**: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

- **MCC9-12.N.Q.2**: Define appropriate quantities for the purpose of descriptive modeling.

- **MCC9-12.N.Q.3**: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Standards for Mathematical Practice

- (1) Make sense of problems and persevere in solving them.
- (2) Reason abstractly and quantitatively.
- (4) Model with mathematics.
- (5) Use appropriate tools strategically.
- (6) Attend to precision.
Common Core Algebra: Unit 1

Introduction

In this task, students will use an inequality to find the distance between two homes. Students will also use the Pythagorean Theorem to find the distance and learn how to convert contextual information into mathematical notation. The second part has students determine how much water might a dripping faucet waste in a year. Students will reason quantitatively and use units to solve problems.

Materials

- colored pencils
- compass (optional)
Common Core Algebra: Unit 1

Acting Out Part 1

Warm-up

In mathematics, the distance between two points is defined as the length of a line segment connecting the two points.

Find the distance between each point A and B.

The Task

Erik and Kim are actors as a local theater. Erik lives 5 miles from the theater while Kim lives 3 miles from the theater.

For the purpose of this task, you will be drawing a “map” to look at where Erik and Kim live.

1. On grid paper, select a any spot for the theater. Mark this spot.
2. Think about Erik and Kim for a moment.

   (a) Is it possible to find the exact spot on the map where Erik lives? Explain your reasoning.

   (b) Is it possible to find the exact spot on the mat where Kim lives? Explain your reasoning.

3. Focusing on where Erik lives, draw a shape that might represent where Erik lives. Once you are done, do the same for Kim.

4. Take a moment to list out any quantities that are involved with this situation. Be sure to indicate if the quantities are constant quantities or variable quantities. Also indicate the units of measure for each quantity.

5. Using grid paper, construct at least two different examples of where Kim and Erik might live.

6. In each of your examples from part(5.) above, find the distance between where Erik and Kim live.

7. If \( d \) were to represent the distance between where Erik and Kim live,

   (a) what is the smallest value of \( d \)?

   (b) what is the largest value of \( d \)?

8. Write a mathematical expression that shows all the possible values of \( d \). Be sure to include an interpretation of what this expression means and how you arrived at your conclusion.
Common Core Algebra: Unit 1

Acting Out Part 2

Warm-up

1. How many days are in a week?
2. Do all months have the same number of days?
3. Do all months have the same number of weeks?
4. What is the average number of days in a month?
5. What is the average number of weeks in a month?
6. How many hours are in a day?
7. How many hours are in a week?
8. How many hours are in a month?

The Task

Kim and Erik are working on a problem at Kim’s apartment. Kim has a leaky faucet in the kitchen and asks Erik to help fix it. Kim estimates that the faucet in her kitchen drips at a rate of 1 drop every 2 seconds.

1. Erik wants to know how many times the faucet drips in a week. Show the necessary steps to calculate this information.

2. Kim estimates that approximately 575 drops will fill a 100 milliliter bucket. Estimate how much water Kim’s faucet is wasting in a given year.
Lucy’s Linear Equations and Inequalities

Mathematical Goals

• Create one-variable linear equations and inequalities from contextual situations.
• Solve and interpret the solution to multi-step linear equations and inequalities in context.

Common Core State Standards

• MCC9-12.A.CED.1: Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.
• MCC9-12.N.Q.3: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Standards for Mathematical Practice

• (1) Make sense of problems and persevere in solving them.
• (2) Reason abstractly and quantitatively.
• (4) Model with mathematics.
• (7) Look for and make use of structure.

Introduction

In this task, students will solve a series of linear equations and inequality word problems that Lucy has been assigned by her teacher. In order to help Lucy, students must explain in detail each step of the problem. It is a good idea to review key words that are associated with linear inequality word problems before beginning this task.

Key words:

• fewer than
• more than
• at most
• at least
• less than
• no less than
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Lucy’s Linear Equations and Inequalities

Warm-up

For each of the problems, develop a mathematical expression or equation. Do not worry about simplifying the expression or solving the equation.

1. Three-fourths of seven
2. Three times a certain number
3. Five more than a certain number
4. Nine and three-tenths less than a certain number
5. Eleven eighths of a certain number is nine less than twice the same number
6. The sum of a number and half its square is thirty-seven.
7. Twice the difference of two unknown numbers is the same as the sum of the same two numbers.
8. Seven less than three times a number is at least twice its square.

The Task

Lucy has been assigned the following linear equations and inequality word problems. Help her solve each problem below by using a five step plan.

The Five Step Plan

a) Drawing a Sketch (if necessary)
b) Defining a Variable
c) Setting up an equation or inequality
d) Solve the equation or inequality
e) Make sure you answer the question

1. The sum of 38 and twice number is 124. Find the number.
2. The sum of two consecutive integers is less than 83. Find the pair of integers with the greatest sum.

3. A rectangle is 12m longer than it is wide. Its perimeter is 68m. Find its length and width.

4. The length of a rectangle is $4 \text{ cm}$ more than the width and the perimeter is at least $48 \text{ cm}$. What are the smallest possible dimensions for the rectangle?

5. Find three consecutive integers whose sum is 171.

6. Find four consecutive even integers whose sum is 244.
7. Alex has twice as much money as Jennifer. Jennifer has $6 less than Shannon. Together they have $54. How much money does each have?

8. There are three exams in a marking period. A student received grades of 75 and 81 on the first two exams. What grade must the student earn on the last exam to get an average of no less than 80 for the marking period?
Common Core Algebra: Unit 1

Forget the Formula

Mathematical Goals

• Rearrange formulas to highlight a quantity of interest.
• Create equations in two variables to represent relationships.
• Understand how the change in one variable affects the other variable in a given situation.
• Write and graph an equation to represent a linear relationship.
• Extend the concepts used in solving numerical equations to rearranging formulas for a particular variable.

Common Core State Standards

• MCC9-12.A.CED.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
• MCC9-12.A.CED.3: Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context.
• MCC9-12.A.CED.4: Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
• MCC9-12.N.Q.1: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
• MCC9-12.N.Q.3: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
• MCC9-12.A.SSE.1: Interpret expressions that represent a quantity in terms of its context.
• MCC9-12.A.SSE.1a: Interpret parts of an expression, such as terms, factors, and coefficients.

Standards for Mathematical Practice

• (1) Make sense of problems and persevere in solving them.
• (2) Reason abstractly and quantitatively.
• (8) Look for and express regularity in repeated reasoning.

Introduction

In this task, students will develop a formula to convert temperatures from Celsius to Fahrenheit and a different formula to convert temperatures from Fahrenheit to Celsius. Students should develop meaning for each equation based on the context of the problem. Each student can develop both equations or the class can be split where part of the class will develop the formula for converting temperatures from Celsius to Fahrenheit, and the remaining students will develop a formula for converting Fahrenheit to Celsius. It is important that students explain the relationship between both formulas.
Forget the Formula

Warm-up

1. What is the freezing point of water in Fahrenheit?
2. What is the boiling point of water in Fahrenheit?
3. What is the freezing point of water in Celsius?
4. What is the boiling point of water in Celsius?

For further investigation, research the reason for why there are two different temperature scales that are commonly used (Celsius and Fahrenheit). Also do research on the Kelvin temperature scale and contrast and compare the three different scales and why they were developed.

The Task

Mrs. Howell, your science teacher, overheard two of her students talking about how to convert temperatures from Celsius to Fahrenheit and vice versa. The students said they knew there was a formula, but they did not remember what it was. Mrs. Howell remarked to you that if they just knew about the freezing point and boiling point of water for each temperature scale, the formula could easily be “rediscovered.”

1. The Celsius and Fahrenheit scales are related in a linear fashion. Write the general equation of a line.

2. Define any quantities that would need to be known for converting from temperature in Celsius to temperature in Fahrenheit.
3. Define two related ordered pairs of Fahrenheit and Celsius temperatures. Explain how each coordinate-pair is a reasonable pair of numbers.

4. Mrs. Howell has asked you to write a written explanation for how to find the formula, showing all your calculations. Using the information from problems (5) through (7).
Common Core Algebra: Unit 1

Cara’s Candles

Mathematical Goals

• Determine whether a point is a solution to an equation.
• Determine whether a solution has meaning in a real-world context.
• Interpret whether the solution is viable from a given model.
• Write and graph equations and inequalities representing constraints in contextual situations.

Common Core State Standards

• **MCC9-12.A.CED.3**: Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context.
• **MCC9-12.N.Q.1**: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
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Standards for Mathematical Practice

• (1) Make sense of problems and persevere in solving them.
• (2) Reason abstractly and quantitatively.
• (3) Construct viable arguments and critique the reasoning of others.
• (4) Model with mathematics.
• (7) Look for and make use of structure.
• (8) Look for and express regularity in repeated reasoning.

Introduction

In this task, students will create a table of values from a given scenario. After answering the question posed students will interpret whether the solution is viable or non-viable in modeling context. Students will also graph the equations to represent linear relationships.

Materials

• colored pencils
• graph paper
• graphing calculator (optional)
Common Core Algebra: Unit 1

Cara’s Candles

Warm-up

Two racers (A and B) are both starting a road race. Racer A gets a 5 minute head-start on Racer B. Racer A can run at a speed of 5.2 miles per hour. Racer B runs at a speed of 6.4 miles per hour. Assuming both runners are running in the same direction, how much distance is there between the two racers after Racer B has been running for 2 minutes?

The Task

Cara likes candles. She also likes mathematics and was thinking about using algebra to answer a question that she had about two of her candles. Her taller candle is 16 centimeters tall. Each hour it burns makes the candle lose 2.5 centimeters in height. Her short candle is 12 centimeters tall and loses 1.5 centimeters in height for each hour that it burns.

1. Cara started filling out the following table to help determine whether these two candles would ever reach the same height at the same time if allowed to burn the same length of time. Finish the table for Cara.

<table>
<thead>
<tr>
<th>Time (hours)</th>
<th>16 cm candle height (cm)</th>
<th>12 cm candle height (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>16</td>
<td>12</td>
</tr>
<tr>
<td>1</td>
<td>13.5</td>
<td>10.5</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Use the data in the table to determine what time the two candles will be at the same height. Also, she wants to know what height the two candles would be at that time.
3. Does your answer from part (2) seem to make sense?

4. What would need to be true in order for the two candles to be able to reach the same height?

5. To help explain your thinking for parts (3) and (4), create a graphical representation of the situation and explain how it helps to support your answers from parts (3) and (4).
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The Yo-Yo Problem


**Mathematical Goals**

- Explore linear patterns.
- Create one variable and two variable linear equations.
- Graph equations on coordinate axes with labels and scales.

**Common Core State Standards**

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- **MCC9-12.N.Q.3**: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
- **MCC9-12.A.SSE.1**: Interpret expressions that represent a quantity in terms of its context.
- **MCC9-12.A.SSE.1a**: Interpret parts of an expression, such as terms, factors, and coefficients.
- **MCC9-12.A.SSE.1b**: Interpret complicated expressions by viewing one or more of their parts as a single entity.

**Standards for Mathematical Practice**

- (1) Make sense of problems and persevere in solving them.
- (2) Reason abstractly and quantitatively.
- (4) Model with mathematics.
- (6) Attend to precision.
- (7) Look for and make use of structure.
- (8) Look for and express regularity in repeated reasoning.
Common Core Algebra: Unit 1

Introduction

The lesson starts with the presentation of the yo-yo problem. Students then complete a hands-on activity involving a design created with pennies that allows them to explore a linear pattern and express that pattern in symbolic form.

Materials

- 31 pennies
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The Yo-Yo Problem

Warm-up

1. What is 8% of 100?
2. What is 12% of 50?
3. What is 3% of 47?
4. Do percentages have a unit? Explain your answer.

The Task (Part 1)

Andy wants to buy a very special yo-yo. He is hoping to be able to save enough money to buy it in time to take a class in which he would learn how to do many fancy tricks. The 5-ounce aluminum yo-yo costs $89.99 plus 6% sales tax. Andy has already saved $17.25, and he is earning $7.20 a week by doing odd jobs and chores.

1. How much sales tax will Andy have to pay?

2. What will be the total cost of the yo-yo, including tax?

3. Let $w$ be the number of weeks that it will take Andy to save enough money to buy the yo-yo. Write an algebraic equation that will help you represent this problem.

4. Solve your equation for $w$, and check your answer. Be prepared to present your solution to the class.
The Yo-Yo Problem

The Task (Part 2)

The Penny Pattern is created in stages by arranging pennies in a very precise way. Stage 1 of the pattern is shown the right (one penny surrounded by six additional pennies). To create each additional stage of the pattern, place more pennies extending out from the six that surround the center penny. Continue making this design until you have used up all of your pennies.

1. On the back of this sheet, sketch the first four stages of the pattern.

2. Using your penny pattern or the sketches of your penny pattern, fill in the table of values:

<table>
<thead>
<tr>
<th>Stage Number $n$</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Pennies Required</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. How many pennies are needed to make stage 6, stage 7, and stage 8 of the penny pattern? How did you determine your answer?

4. Write an algebraic model that expresses the relationship between the stage number, $n$, and the number of pennies required to make that design, $p$.

5. Use your model to determine how many pennies are needed to make stage 80, stage 95, and stage 100 of the penny pattern.
6. If you use 127 pennies to make the penny pattern, how many pennies will be in each spoke coming out from the center penny?
Common Core Algebra: Unit 1

Paper Folding

Adapted from PBS Mathline: http://www.pbs.org/teacherline/vma/upload/Rhinos.pdf

Mathematical Goals

• Write and graph an equation to represent an exponential relationship.
• Model a data set using an equation.
• Choose the best form of an equation to model exponential functions.
• Use properties of exponents to solve and interpret the solution to exponential equations in context.
• Graph equations on coordinate axes with labels and scales.

Common Core State Standards

• MCC9-12.A.CED.1: Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.
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• MCC9-12.A.SSE.1a: Interpret parts of an expression, such as terms, factors, and coefficients.
• MCC9-12.A.SSE.1b: Interpret complicated expressions by viewing one or more of their parts as a single entity.

Standards for Mathematical Practice

• (1) Make sense of problems and persevere in solving them.
• (2) Reason abstractly and quantitatively.
• (3) Construct viable arguments and critique the reasoning of others.
• (4) Model with mathematics.
• (6) Attend to precision.
• (7) Look for and make use of structure.
• (8) Look for and express regularity in repeated reasoning.
Common Core Algebra: Unit 1

Introduction

Students will use paper folding to model exponential functions. Students will collect data, create scatterplots, and determine algebraic models that represent their functions. Students begin this lesson by collecting data within their groups. They fold a sheet of paper and determine the area of the smallest region after each fold. Next they draw a scatterplot of their data and determine by hand an algebraic model. This investigation allows students to explore the patterns of exponential models in tables, graphs, and symbolic form.

Materials

- graphing calculator (optional)
- graph paper
Folding Paper (Part 1)

1. Take an 8.5 x 11” sheet of paper and fold it in half. How many sections is the paper folded into?

2. Unfold the paper from part (1). Fold the paper in half. Without opening the paper, fold it in half again. How many sections is the paper folded into?

3. Now imagine a sheet of paper starts off not folded. The paper is folded in half, then folded in half again, and folded in half one more time. How many sections is the paper folded into?

4. Use a sheet of paper and/or your findings from parts (1) through (3) to complete the table below. This table relates the number of folds to the number of sections a sheet of paper is folded into.

<table>
<thead>
<tr>
<th>Number of Folds</th>
<th>Number of Sections</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
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<tr>
<td>2</td>
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<td>7</td>
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<tr>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

5. Using graph paper, make a scatter plot of your data.

6. Determine a mathematical model for the data in your table.

Folding Paper (Part 2)

1. Think about the total area for the sheet of paper. If the total area was measured using the units of “sheets”, how much area would a sheet of paper cover?

2. Would the area that the sheet cover be the same if it was folded once? Justify your answer.

3. What if the sheet was folded...
   
   (a) Twice?
   
   (b) Three times?
   
   (c) Four times?
   
   (d) Zero times?
4. If the sheet of paper was folded in the same way as part one, complete the table below that relates the number of folds and the area of each section of the paper (after it has been unfolded).

<table>
<thead>
<tr>
<th>Number of Folds</th>
<th>Area of Each Sections</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
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<td>3</td>
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<td>7</td>
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<td>8</td>
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</tbody>
</table>

5. Using graph paper, make a scatter plot of your data.

6. Determine a mathematical model for the data in your table.
Mathematical Goals

• Create one-variable exponential equations from contextual situations.
• Use properties of exponents to solve and interpret the solution to exponential equations in context.
• Write and graph an equation to represent an exponential relationship.
• Graph equations on coordinate axes with labels and scales.
• Use technology to explore exponential graphs.

Common Core State Standards

• MCC9-12.A.CED.1: Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.
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Common Core Algebra: Unit 1

Standards for Mathematical Practice

- (1) Make sense of problems and persevere in solving them.
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- (8) Look for and express regularity in repeated reasoning.

Introduction

This task introduces students to exponential functions. At this point in their study, students have extended their understanding of exponents to include all integer values but have not yet discussed rational or real number exponents. In Part 1, students investigate a mathematical model of spreading a rumor in which the domain of the function is limited to a finite set of nonnegative integers. In Part 2, students learn the definition of an exponential function and see the model from Part 1 as an example of such a function. The emphasis in Part 2 is the pattern for the formula of an exponential function and an introduction to the shape of the graph. In Part 3, students work with the compound interest formula.

Materials

- Graph paper
- Graphing utility
- Optional: spreadsheet software
Linda’s lifelong dream has been to open her own business. After working, sacrificing, and saving, she finally has enough money to open up an ice cream business. The grand opening of her business is scheduled for the Friday of Memorial Day weekend. She would like to have a soft opening for her business on the Tuesday before. The soft opening should give her a good idea of any supply or personnel issues and give her time to correct them before the big official opening.

A soft opening means that the opening of the business is not officially announced; news of its opening is just spread by word of mouth (in this case, a rumor started by Linda). Linda needs a good idea of when she should begin the rumor in order for it to spread reasonably well before her soft opening. She has been told that about 10% of the people who know about an event will actually attend it. Based on this assumption, if she wants to have about 50 people visit her store on the Tuesday of the soft opening, she will need 500 people to know about it.

Linda plans to tell one new person each day about the soft opening and will ask that person to tell one other new person each day so that the news gets passed on.

1. If Linda just started this process, how many new people will know about the soft opening...

(a) After 1 day?

(b) After 2 days?
2. Assume that each new person who hears about the soft opening is also asked to tell one other person each day of the opening and that each person starts the process of telling their friends on the day after he or she first hears about the soft opening. When should Linda begin telling others about the soft opening in order to have at least 500 people know about it by the day it occurs? (Be sure to justify your reasoning and answer)

3. Let $x$ represent the day number and let $y$ be the number of people who know about the soft opening on day $x$. Consider the day before Linda told anyone to be Day 0, so that Linda is the only person who knows about the opening on Day 0. Day 1 is the first day that Linda told someone else about the opening.

(a) Complete the following table

<table>
<thead>
<tr>
<th>Day</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of people who know</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(b) Graph the information in part (a)

4. Write an equation that describes the relationship between $x$, day, and $y$, number of people who know, for the situation of spreading the news about the soft opening of Linda’s ice cream store.
5. Does your equation describe the relationship between day and number who know about Linda’s ice cream store soft opening completely? Why or why not?
The spread of a rumor or the spread of a disease can be modeled by a type of function known as exponential function; in particular, an exponential growth function. An exponential function has the form

\[ f(x) = a \cdot b^x \]

where \( a \) is a non-zero real number and \( b \) is a positive real number other than 1. An exponential growth function has a value of \( b \) that is greater than one.

1. In the case of Linda's ice cream store, what values of \( a \) and \( b \) yield an exponential function to model the spread of the rumor of the soft store opening?

2. Recalling the condition of Linda's case from part 1, what is an appropriate domain for the exponential function? What range corresponds to this domain?

3. In part 1, you drew a portion of the graph of this function. Does it make sense to connect the dots on the graph? Why or why not?
4. How would the graph change if Linda had told two people each day rather than one and had asked that each person also tell two other people each day?

5. How would the equation from part 1 change if Linda had told two people each day rather than one and had asked that each new person also to tell two other people each day? What would be the values of $a$ and $b$ in this case?

6. Given the new situation for Linda, how long would it take for at least 500 people to find out about the opening if the rumor spread at this new rate?
How in the world did Linda ever save enough to buy the franchise to an ice cream store? Her mom used to say, “Linda could squeeze a quarter out of a nickel!” The truth is that Linda learned early in life that patience with money is a good thing. When she was just about 9 years old, she asked her dad if she could put her money in the bank. He took her to the bank and she opened her very first savings account.

Each year until Linda was 16, she deposited her birthday money into her savings account. Her grandparents (both sets) and her parents each gave her money for her birthday that was equal to twice her age; so on her ninth birthday, she deposited $54 ($18 from each couple of grandparents/parents).

Linda’s bank paid her 3% interest, compounded quarterly. The bank calculated her interest using the following standard formula:

\[ A = P \left(1 + \frac{r}{n}\right)^{nt} \]

where \( A \) is the final account balance after \( t \) years compounded \( n \) times per year at an interest rate of \( r \) with a principal amount of \( P \) dollars.

1. Verify the first entry in the following chart, and then complete the chart to calculate how much money Linda had on her 16th birthday. Do not round answers until the end of the computation, then give the final amount rounded to the nearest cent.

<table>
<thead>
<tr>
<th>Age</th>
<th>Birthday Money</th>
<th>Amount from previous year plus birthday money</th>
<th>Total balance at end of the year</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>$54</td>
<td>0</td>
<td>$55.63831630</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>
On her 16th birthday, the budding entrepreneur asked her parents if she could invest in the stock market. She studied the newspaper, talked to her economics teacher, researched a few companies and finally settled on the stock she wanted. She invested all of her money in the stock and promptly forgot about it. When she graduated from college on her 22nd birthday, she received a statement from her stocks and realized that her stock had appreciated an average of 10% per year.

2. How much was her stock worth on her 22nd birthday?
When Linda graduated from college, she received an academic award that carried a $500 cash award. On her 22nd birthday, she used the money to purchase additional stock. She started her first job immediately after graduation and decided to save $50 each month. On her 23rd birthday she used the $600 (the total of her monthly savings) to purchase new stock. Each year thereafter she increased her the total of her savings by $100 and, on her birthday each year, used her savings to purchase additional stock. Linda continued to learn about stocks and managed her accounts carefully. On her 35th birthday she looked back and saw that her stock had appreciated at 11% during the first year after college and that the rate of appreciation increased by 0.25% each year thereafter. At age 34, she cashed in enough stock to make a down payment on a bank loan to purchase her business.

3. What was her stock worth on her 34th birthday? Use a table like the one below to organize your calculations.

<table>
<thead>
<tr>
<th>Age</th>
<th>Balance from previous year</th>
<th>Amount Linda added from yearly savings</th>
<th>Amount invested for the year</th>
<th>Interest rate for the year</th>
<th>Balance at end of year end</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>$998.01</td>
<td>$500</td>
<td>1498.01</td>
<td>11.00%</td>
<td>1662.79</td>
</tr>
<tr>
<td>23</td>
<td>$1662.79</td>
<td>$600</td>
<td></td>
<td>11.25%</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td></td>
<td></td>
<td></td>
<td>11.50%</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td>11.75%</td>
<td></td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

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