Algebra 1

Unit 2: Reasoning with Linear Equations & Inequalities

MAThew M. Winking
Find the value for the variable that makes the statement true. (SHOW WORK NEATLY)

1. \(2y - 4 + 5y = 4 - 3y + 5\)
2. \(3g - 6 + 2g + 1 = 11 - 8g\)
3. \(-7x = 91\)
4. \(123 = 3m\)
5. \(\frac{2}{3}x = 12\)
6. \(3x + 2 = 14\)
7. \(2a - 6 = 5a\)
8. \(32 = -8 - 10b\)
9. \(3(m - 4) + 2m = 8\)
10. \(-2(h - 3) + 5h = 5(2 + h)\)

I. Eliminate parenthesis by distributing.

\[2(3x - 4) = 5\]
\[6x - 8 = 5\]

II. Eliminate fractions by multiplying each term by the lowest common denominator.

\[\frac{1}{3}x - \frac{1}{2} = \frac{x}{4}\]
\[\frac{12}{3} \cdot \frac{1}{3} - \frac{12}{1} \cdot \frac{1}{2} = \frac{12}{1} \cdot \frac{x}{4}\]
\[4x - 6 = 3x\]

III. Combine like terms on each side of the equation.

\[4x + 2 - 7x = 2 + x + 8\]
\[-3x + 2 = 10 + x\]

IV. Move the "variable" term to one side of the equation and the constants to the other side using addition or subtraction.

\[\frac{3}{2}x + 2 = 6x - 5\]
\[-\frac{3}{2}x\]
\[\frac{2}{3} = 3x - 5\]
\[+\frac{5}{3}\]
\[7 = 3x\]

V. Divide both sides by the coefficient (the number in front of the variable).

\[4x = 12\]
\[\frac{4x}{4} = \frac{12}{4}\]
\[x = 3\]
11. $2(w - 3) - 2w = 7$
12. $3(2a + 3) - 2a = 2(5 + 2a) - 1$

13. $\frac{1}{3}x + \frac{3}{2} - \frac{5}{6}x = 3$
14. $\frac{2}{5}(x - 6) = \frac{5}{2}$

I. Eliminate parenthesis by distributing.

\[
2(3x - 4) = 5
\]

II. Eliminate fractions by multiplying each term by the lowest common denominator.

\[
\frac{1}{3}x - \frac{1}{2} = \frac{x}{4}
\]

\[
\frac{12}{1} \cdot \frac{1}{3}x - \frac{12}{1} \cdot \frac{1}{2} = \frac{12}{4} \cdot \frac{x}{1}
\]

\[
4x - 6 = 3x
\]

III. Combine like terms on each side of the equation.

\[
4x + 2 - 7x = 2 + x + 8
\]

\[
-3x + 2 = 10 + x
\]

IV. Move the "variable" term to one side of the equation and the constants to the other side using addition or subtraction.

\[
\begin{align*}
3x + 2 &= 6x - 5 \\
3x &= 6x - 5 - 2 \\
3x &= 3x - 5 \\
3x &= 3x - 5 + 5 \\
7 &= 3x
\end{align*}
\]

V. Divide both sides by the coefficient (the number in front of the variable).

\[
\begin{align*}
4x &= 12 \\
\frac{4x}{4} &= \frac{12}{4} \\
x &= 3
\end{align*}
\]
17. \[ \frac{3}{2} \left( \frac{1}{2} x - \frac{4}{6} \right) = \frac{5}{2} x + 5 \]

18. \[ 3t + 4x = 6 - 2x \] (solve for \( t \))

19. \[ 2(x + 2y) - 2 = 3x + 3 \] (solve for \( y \))

20. \[ ax + 2b = 5b - c \] (solve for \( b \))

21. If \( 3a + 1 - a = 9 \) then what is the value of \( 5a + 2 \)?
22. \( \frac{2x + 1}{3} = \frac{x + 1}{2} \)

23. \( \frac{x + 1}{3} + \frac{2x - 1}{2} = \frac{3x - 1}{6} \)

24. \( 2^x = 64 \)

25. \( 3^x = 243 \)

26. \( 5^x = 125 \)
1. The distance a car travels can be found using the formula 
\[ d = r \cdot t, \] where \( d \) is distance, \( r \) is rate of speed, and \( t \) is time. How many miles does the car travel, if it drives at an average rate of speed of 60 miles per hour for a period of time of \( \frac{3}{4} \) of an hour?

2. The distance a car travels can be found using the formula 
\[ d = r \cdot t, \] where \( d \) is distance, \( r \) is rate of speed, and \( t \) is time. What is the average rate of speed, if the person drives a distance of 208 miles in 4 hours?

3. A person borrows money from a friend and they decide to use a simple interest formula. 
\[ I = P \cdot R \cdot T \] where \( I \) is the interest in dollars, \( P \) is the principle (original money loaned) in dollars, \( R \) is the interest rate, and \( T \) is the time in years. If the person borrowed $2600 for 5 years at a rate of 3%, how much interest will they owe for the loan?

4. A person borrows money from a friend and they decide to use a simple interest formula. 
\[ I = P \cdot R \cdot T \] where \( I \) is the interest in dollars, \( P \) is the principle (original money loaned) in dollars, \( R \) is the interest rate, and \( T \) is the time in years. If the person paid $768 in interest for a loan over 5 years at a rate of 4%, how much money did they original borrow?

5. A certain population of bacteria has an average growth rate of 0.04 bacteria per hour. The formula for the growth of the bacteria’s population is 
\[ A = P_o (2.718)^{0.04t}, \] where \( P_o \) is the original population, \( t \) is time in hours, and \( A \) is the new population. If we begin with 50 bacteria (\( P_o \)), about how many bacteria will there be after 20 hours?

6. A certain population of bacteria has an average growth rate of 0.06 bacteria per hour. The formula for the growth of the bacteria’s population is 
\[ A = P_o (2.718)^{0.06t}, \] where \( P_o \) is the original population, \( t \) is time in hours, and \( A \) is the new population. If the current population of a culture was 3000 bacteria (\( A \)) and it started growing 30 hours ago, what was the original size of the bacteria (\( P_o \))? 
7. Find the dimensions of the rectangle if the perimeter is 20.

\[(2x - 4) \quad (2x + 2)\]

8. Find the each side of the triangle if the perimeter is 23.

\[2x - 5 \quad 3x + 1 \quad 4x\]

9. One more than twice a number is 11. What is the number?

10. 4 times the difference of 4 and a number is 24. What is the number?

11. My son is 9 less than \(\frac{1}{2}\) my age. If I am 34 how old is my son?

12. Four less than a number tripled is the same number increased by ten. What is the number?

13. If the difference of twice a number and 8 is tripled the result is 18. What is the unknown number?

14. The quotient of a number and 2 is decreased by 3 and the result is 5. What is the number?
15. 5 subtracted from 4 times a number is 27. What is the number?

16. 3 times a number plus 5 is the same number increased by 17. What is the number?

17. 4 less than number is the same as twice the number reduced by 12. What is the number?

18. Four less than the product of a number and 8 is twice the sum of the number and 10. What is the number?

19. Five times the difference of twice a number and three is twenty-five. What is the number?

20. Three is subtracted from a number that is doubled this entire result is tripled which equals twenty one. What is the number?

21. The quotient of 3 less than twice a number and 5 is equal to the sum of 4 and the same number divided by 2. What is the number?

22. Two classrooms have a total of 45 people in them. The first class is a math class with 5 more students than the science class. How many are in each class?

23. Two numbers total 44. The first number is 1 less than twice the second. What are the two numbers?

24. A husband and wife have a combined income of $74,000 a year. The wife makes $10,000 less than twice as much has her husband makes. How much do they each earn?
25. The difference of two numbers is 20. The larger of the two numbers is 2 more than twice the smaller. What are the two numbers?

26. Mark is 3 less than 4 times as old as Tim. Together their ages total 42. How old is each person?

27. An angle’s is equal to 30 less than twice its supplement. What is the angle?

28. An angle is equal to 24 more than twice its complement. What is the angle?

29. Jessica is 4 years older than Jeff. Keisha is twice as old as Jeff. The total of all three of their ages is 60. How old is each person?

30. Consider the 3 interior angles of a triangle. The second angle is 30 less than twice the first. The third is 10 more than twice the first. What are the three angle measures?

31. The check for a restaurant comes and due to a coupon it was reduced by 5 dollars. Four friends split the tab evenly after the coupon. Each friend paid $6.50. How much was the original check?

32. A person purchased 4 tires. The person had a coupon for 10% off. In the end each tire ended up costing $44.00 a piece. How much was the original total bill before the coupon?
Find the values for the variable that makes the statement true. (SHOW WORK NEATLY)

1. $3x > 6$
2. $20 \geq 4m$
3. $-3x < 12$
4. $3b + 2 \leq 20$
5. $8a - 12 > 2a$
6. $2p - 6 + 2p + 1 \leq 11 + 8p$

I. Eliminate parenthesis by distributing.

Example: $2(3x - 4) > 5$

$6x - 8 > 5$

II. Eliminate fractions by multiplying each term by the lowest common denominator.

Example: \[
\frac{1}{3}x - \frac{1}{2} \leq \frac{x}{4}
\]

Example: \[
\frac{12}{1}x - \frac{12}{1} \leq \frac{12}{1} \cdot \frac{x}{4}
\]

$4x - 6 \leq 3x$

III. Combine like terms on each side of the equation.

Example: \[
4x + 2 - 7x > 2 + x + 8
\]

$-3x + 2 > 10 + x$

IV. Move the "variable" term to one side of the equation and the constants to the other side using addition or subtraction.

Example: \[
\frac{3x + 2 \geq 6x - 5}{-3x}
\]

$\frac{-3x}{-3x} \geq \frac{2 \geq 3x - 5}{+5} + \frac{+5}{+5}$

$7 \geq 3x$

V. Divide both sides by the coefficient (the number in front of the variable).

Example: \[
\frac{-4x > 12}{-4}
\]

$\frac{-4x}{-4} > \frac{12}{-4}$

$x < 3$
Find the values for the variable that makes the statement true. (SHOW WORK NEATLY)

9. \(2^x > 32\)  
10. \(5^x \leq 125\)

Write an inequality statement for each graph using \(x\).

11. \([-10, -5, 0, 5, 10]\)
12. \([-10, -5, 0, 5, 10]\)

Solve the following inequalities for the requested variable.

13. \(4x - 2y \geq 6 - 2x\)  (solved for \(y\))  
14. \(3(a - b) + 5b < 8b - 12\)  (solved for \(a\))
Each system of equation is shown in graph. Using the graph find the solutions to each of the systems.

1. \( y = \frac{2}{3}x + 3 \)
2. \( y = x^2 - 3 \)
3. \( y = 2x - 2 \)

Which of the system of equations below have a solution of \((-3, 2)\)?

4. \[
\begin{align*}
   y &= 2x + 8 \\
   3x + 2y &= -5
\end{align*}
\]
5. \[
\begin{align*}
   y &= \frac{2}{3}x + 4 \\
   x &= \frac{1}{2}y - 2
\end{align*}
\]
6. \[
\begin{align*}
   y + 2x &= -4 \\
   3y + x &= 6
\end{align*}
\]

Graph each system and use the graph to determine a solution.

7. \[
\begin{align*}
   y &= \frac{1}{2}x - 4 \\
   y + 2x &= 1
\end{align*}
\]
8. \[
\begin{align*}
   y &= -3x - 6 \\
   -2x + 3y &= 15
\end{align*}
\]
Each system of equations is shown in graph. How many solutions does each system have?

9. \( y = \frac{1}{2}x - 2 \)
   \( y = \frac{1}{2}x + 1 \)

10. \( y = \frac{1}{3}x + 1 \)
    \( y = -2x + 4 \)

11. \( y = -\frac{2}{3}x + 2 \)
    \( y = -\frac{2}{3}x + 2 \)

Graph each system and use the graph to determine a solution.

9. \( 3y = 2x - 6 \)
   \( 4x - 6y = 12 \)

10. \( 4y - 7 = 2x + 1 \)
    \( 2y - x = -6 \)

11. \( 2x = y + 2 \)
    \( 3y = -2x + 9 \)
Solve each of the following systems using the **substitution** method.

1. \( y = 2x + 5 \)
   \[ 3x + 2y = -4 \]

2. \( 2x - 3y = 6 \)
   \[ x = 3y \]

3. \( y = 3x + 8 \)
   \[ y = 4 + x \]

4. \( 4x + 2y = 4 \)
   \[ x - 3y = 15 \]
Solve each of the following systems using the **substitution** method.

5. \[ x = 2y - 1 \]
   \[ 2x - 4y = -2 \]

6. \[ 2x - 2y = 3 \]
   \[ y = x - 5 \]

Solve each of the following systems using the **elimination** method.

7. \[ 2x - 3y = 9 \]
   \[ 3x + 4y = 5 \]

8. \[ -3x + 4y = -8 \]
   \[ 3x + y = -17 \]
Solve each of the following systems using the **elimination** method.

9. \[ 4x - 2y = 6 \]
   \[ -6x + 3y = -9 \]

10. \[ 2x - 2y = 4 \]
    \[ 6x + 5y = 3 \]

11. \[ -6x - 3y = 9 \]
    \[ 10x + 5y = 4 \]

12. \[ 2y + 4x = 3 \]
    \[ 3x = y + 4 \]
1. The Turbo Taxi Service charges a flat rate of $5 and then $0.40 per mile. The Express Taxi Company charges a flat rate of $2 and then $0.75 per mile.
   
a. Write an equation that describes the cost, c, of each taxi cab in terms of miles, m, driven.

   Turbo Taxi Service: \[ c = \]
   
   Express Taxi Co: \[ c = \]

   b. When do the two taxi cabs charge the same amount?

   c. Describe when the Express Taxi Company charges more than Turbo Taxi Services.

2. Theresa was taking her 2 grandchildren to the zoo. Theresa purchased 1 adult ticket for herself and 2 children’s tickets for $18.20. A family of 5 were also visiting the zoo. The family purchased 2 adult and 3 children’s tickets for $30.90.

   a. Write an equation that describes each purchase:

   Theresa:
   
   Family:

   b. Solve the system to determine how much an adult’s ticket costs for the zoo.
3. A sales person that worked at a cell phone store recorded the following information about the number of Android phones and iPhones that he sold for the day:

- He sold a total of 24 smartphones that were either an iPhone or an Android phone.
- The iPhones that he sold were all priced at $200 and the all of the Android phones were priced at $150. He sold a total of value of $4150 in smartphones.

a. Write an equation that describes each piece of information. Let ‘P’ represent the number of iPhones and ‘A’ represent the number of Android Phones.

Total Number:

Total Sales:

b. Using the system of equations determine the number of each type of phone that was sold.

4. A local school sold 230 tickets for their performance of Hamlet. They sold a combination of regular tickets and student tickets. The regular tickets sold for $8 each and the student tickets sold for $5. That night they collected $1522 in ticket sales.

a. Write an equation that describes each piece of information. Let ‘R’ represent the number of regular tickets and ‘S’ represent the number of Student tickets.

b. Using the system of equations determine the number of each type of ticket that was sold.
5. At the Hardware store, they sell 6 pound bags of grass seed for $15 and they sell 20 pound bags of grass seed for $40. A landscaping company purchased a total of 14 bags of the grass seed mentioned and paid a total of $435. How many of each type of bag did the company purchase?

6. Janice left home at 12:00 pm. She drove to the airport at an average speed of 40 miles per hour. The airport is a distance of 70 miles away from her house. Her husband, Mike, realized she forgot to take her bathroom bag for her trip and left the same house at 12:30 pm to go to the airport. He average 60 miles per hour on the trip.

a. Let ‘y’ represent the distance each person is away from their house and ‘x’ represent the number of hours traveled after 12:00pm. Write an equation describing each person’s distance away from their house.

Janice:

Mike:

b. Graph the system of equations below:

c. Will Mike catch up to Janice before she gets to the airport? If so, at what time would he catch up with her?

d. Approximately what time would each arrive at the airport?
7. CarStax is a used car dealership. At CarStax they pay their salespeople $550 a week plus $150 for each car they sell. Andy’s Autos is another used car dealership. At Andy’s they pay their salespeople $400 a week plus $180 for each car sold

a. Let ‘y’ represent the amount a sales person earns in a week and ‘x’ represent the number of cars sold each week. Write an equation describing each dealership’s salary for a sales person.
   
   CarStax:
   
   Andy’s Autos:

b. Graph the system of equations below:

c. At what point do the two dealerships pay the salesperson the same amount?

d. Determine when each dealership pays a higher salary.
Sec 2-7 Systems of Inequalities

1. Graph the following inequalities:
   a. $y \leq \frac{3}{4}x - 2$
   b. $y > -2x + 4$
   c. $3y + 9x \geq 3x - 12$
   d. $3x - 8 < -2y$
2. Graph the following inequalities:
   a. \( y \leq 3 \)  
   b. \( x > -5 \)

3. Graph the following systems inequalities:
   a. \( y > \frac{1}{2}x - 4 \)  
   \( -2x \geq y - 3 \)
   b. \( 3y + 2x \leq 6 \)  
   \( 3y > y - 4 \)
4. Graph the following systems of inequalities:

a. \( y > \frac{1}{3}x - 4 \)

\[ y \leq \frac{1}{3}x + 2 \]

b. \( y \geq -2x + 4 \)

\[ y < -2x - 2 \]

5. Mary works at two part-time jobs. The first job at Bull’s Eye pays $12 per hour and her second job at CSV pays $10 per hour. She must earn at least $360 a week to pay her bills.

a. Write an inequality that shows how much she could work at each job to earn at least $360 per week. Let ‘x’ be the number of hours she works at Bull’s Eye and ‘y’ be the number of hours she works at CSV.

b. Write base inequalities suggesting that she must work zero hours or more at each job.

c. Graph the system of inequalities to show the possible number of hours she could work at each job.
6. Marco is the activities director at the local boys club. He needs to purchase new sports equipment, and he would like to purchase new basketballs and new soccer balls. He has $450 in his equipment budget and he would like to buy at least 15 balls. Soccer balls are $15 each and basketballs are $30 each.

a. Write an inequality that shows he can’t spend more than $450. Let ‘x’ represent the number of basketballs and ‘y’ represent the number of soccer balls.

b. Write an equation that shows he needs at least 15 balls.

c. Write base inequalities suggesting that he must purchase 0 balls or more of each type.

d. Graph the system of inequalities to show the possible purchases of each type of ball that could be made.
Sec 2.8 – Function
Introduction: What’s a Function?

A coke machine is a good example of a relation that is a function. In the machine above assume the price for a soft drink is listed at $1.30 and the top button shows a picture of a 16 oz Coca Cola bottle.

1. If you were to put 2 dollar bills into the coke machine and press the top button what would you get in return?

2. If your repeated the action in step #1 what would happen? And again?

3. What would happen if you put in 8 quarters and pushed the top button? (Remember that is a different input)

4. ORDERED PAIRS: Which of the sets of ordered pairs could be considered a function? List the domain and range if it is a function.
   a. \{(3,5), (2,6), (-5,3), (-7,1), (2,1)\}
   b. \{(-2,1), (3,2), (5,2), (-6,5), (-2,1)\}
   c. \{(7,2), (5,8), (3,1), (2,9), (-5,7)\}

5. TABLES: Which of the sets of ordered pairs in each table could be considered a function? List the domain and range if it is a function.
   a. | Input | -2 | 0 | 2 | 4 | 6 |
      | Output| 0.25 | 1 | 4 | 16 | 64 |
   b. | x     | 2 | 0 | 2 | 4 | 6 |
      | y     | 4 | -2 | 4 | 3 | 4 |
   c. | x     | 1 | 4 |
      | y     | 2 | 3 |
      | y     | 1 | 4 |
      | y     | 2 | 2 |
      | y     | 3 | 5 |

Name:
6. **MAPPINGS**: Which of the mappings could be considered a function?

   a. ![Mapping A]
   
   **circle one:**
   - Function
   - Not a Function

   b. ![Mapping B]
   
   **circle one:**
   - Function
   - Not a Function

   c. ![Mapping C]
   
   **circle one:**
   - Function
   - Not a Function

7. **GRAPHS**: Which of the graphs could be considered a function? List the domain and range if it is a function.

   a. ![Graph A]
   
   **circle one:**
   - Function
   - Not a Function
   
   **Domain:**
   **Range:**

   b. ![Graph B]
   
   **circle one:**
   - Function
   - Not a Function
   
   **Domain:**
   **Range:**

   c. ![Graph C]
   
   **circle one:**
   - Function
   - Not a Function
   
   **Domain:**
   **Range:**

   d. ![Graph D]
   
   **circle one:**
   - Function
   - Not a Function
   
   **Domain:**
   **Range:**

   e. ![Graph E]
   
   **circle one:**
   - Function
   - Not a Function
   
   **Domain:**
   **Range:**

   f. ![Graph F]
   
   **circle one:**
   - Function
   - Not a Function
   
   **Domain:**
   **Range:**
8. **SITUATIONAL EXAMPLES**: Which of the situations could be considered a function?
   List the domain and range if it is a function.

   a. A school administrator is using a database program called SASI.
      The administrator types a student number in the top box and the program returns the number of missed days in the bottom box. Each student has a unique ID number and the maximum number of absences any student has is 12 days.

   b. A teacher starting her first day of class tells the class that she will call out their first name and then the student is to respond with the total number of brothers and sisters they have. In the class there are 2 different students named Matt. The first student named Matt has 2 siblings the other has 4 siblings.

   c. The Yellow Taxi Cab Company in a city charges $3.00 as soon as you get in the cab and then an additional $0.50 for each mile they drive their customers. They are limited to driving a maximum distance of 20 miles.

   
   
   

   

   

   

   9. Which of the equations could be written such that \( y \) is a function of \( x \)?
   Circle each equation that could be written such that \( y \) is a function of \( x \).

   a. \( y = 3x + 1 \)   b. \( y^2 = x^2 \)   c. \( y = \pm 2^x \)   d. \( y^3 = x + 1 \)   e. \( y^4 + y = x^2 \)

   

   

   

   

   10. **FUNCTION NOTATION**. Given the function \( f(x) = 3x + 2 \), determine the following:

   a. \( f(3) \)   b. \( f(t + 1) \)   c. What is \( x \) if \( f(x) = 17 \)?

   

   

   

   

   11. **FUNCTION NOTATION**. Given the function \( d(x) = x^2 + 3^x \), determine the following:

   a. \( d(2) \)   b. \( d(0) \)
12. **FUNCTION NOTATION**. Given the function \( g(x) \) determine the following:
   a. \( g(0) \)
   b. \( g(4) \)
   c. What is \( x \) if \( g(x) = 4 \)?

13. **FUNCTION NOTATION**. Given the graph of the function \( h(x) \) determine the following:
   a. \( h(1) \)
   b. \( h(3) \)
   c. What is \( x \) if \( h(x) = 1 \)?

14. **FUNCTION NOTATION**. Given the function \( b(x) \): \( \{(2,3), (1,4), (4,2), (5,3), (3,0)\} \), determine the following:
   a. \( b(2) \)
   b. \( b(3) \)
   c. What is \( x \) if \( b(x) = 3 \)?

15. **FUNCTION NOTATION**. Given \( f(8) = (8)^2 + 2(8) \), determine a possible equation for \( f(x) \)

16. **FUNCTION NOTATION**. Given the partial set of values for the function \( h(x) \), determine a possible equation for \( h(x) \).

17. **FUNCTION NOTATION**. Given the partial set of values for the function \( h(x) \), determine a possible equation for \( h(x) \).
1. Write an equation to describe each linear function graphed below.

A.  

\[ f(x) = \]

B.  

\[ h(x) = \]

C.  

\[ g(x) = \]

2. Write an equation to describe each linear function graphed below.

A. The linear function, \( f(x) \), has a slope of \( \frac{1}{2} \) and a y-intercept of 4.

\[ f(x) = \]

B. The linear function, \( g(x) \), passes through the point (3,1) and has a slope of \( \frac{3}{4} \).

\[ g(x) = \]

C. The linear function, \( h(x) \), passes through the points (2, 4) and (6, 2).

\[ h(x) = \]

D. The linear function, \( p(x) \), is parallel to the function \( t(x) = \frac{1}{2}x + 2 \) and passes through the point (8, 1).

\[ p(x) = \]
3. Write an equation to describe each **linear function** graphed below.

A. Determine an equation that describes \( d(x) \) based on the partial set of values in the table below.

<table>
<thead>
<tr>
<th>( x )</th>
<th>(-2)</th>
<th>(0)</th>
<th>(2)</th>
<th>(4)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( d(x) )</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
</tbody>
</table>

\[ d(x) = \]

B. Determine an equation that describes \( m(x) \), given that \( m(x) \), is parallel to \( f(x) \) (shown in the graph at the right) and it passes through the point \((3, -2)\).

\[ m(x) = \]

4. Consider the **exponential function**, \( f(x) = 2^x \).
   A. Fill in the missing values in the table below.

   \[
   \begin{array}{c|c}
   x & f(x) \\
   \hline
   3 & \ \\
   0 & \ \\
   4 & \ \\
   1 & \ \\
   -1 & \ \\
   -3 & \ \\
   \end{array}
   \]

   B. Plot the points from the table and sketch a graph

   Label any asymptotes.

5. Consider the **exponential function**, \( g(x) = 3^x - 2 \).
   A. Fill in the missing values in the table below.

   \[
   \begin{array}{c|c}
   x & g(x) \\
   \hline
   2 & \ \\
   3 & \ \\
   1 & \ \\
   0 & \ \\
   -1 & \ \\
   -3 & \ \\
   \end{array}
   \]

   B. Plot the points from the table and sketch a graph

   Label any asymptotes.
6. For each of the functions, determine the asymptote and sketch a graph (label the points when $x = 0$ and when $x = 1$.)
   A. $f(x) = 4^x - 4$
   B. $g(x) = \left(\frac{1}{2}\right)^x + 1$
   C. $h(x) = 2 \cdot 3^x - 3$

7. Create two different exponential functions of the form $f(x) = a \cdot b^x + c$ that have a horizontal asymptote at $y = 2$.

8. Given the function $f(x)$ is of the form $f(x) = a \cdot b^x + c$, has a horizontal asymptote at $y = 2$, and passes through the point $(0,5)$, create a possible function for $f(x)$.

9. Tell which functions below could represent exponential growth or exponential decay.

<table>
<thead>
<tr>
<th>$x$</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>$f(x)$</td>
<td>3</td>
<td>5</td>
<td>7</td>
<td>9</td>
<td>13</td>
</tr>
<tr>
<td>$g(x)$</td>
<td>65</td>
<td>33</td>
<td>17</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>$h(x)$</td>
<td>3</td>
<td>7</td>
<td>19</td>
<td>55</td>
<td>163</td>
</tr>
</tbody>
</table>

10. In a science experiment, a student is measuring the height of a plant each week. The student began the project on week 0 with the plant already 4 inches tall. The student determined that the plant would increase in height by 20% each week (for the first 10 weeks). Create an exponential function of the form $f(t) = a \cdot b^t$ that describes the height of the plant as a function of $t$, where $t$ is the number of weeks after the project began.
1. What is the **domain** and **range** of the function described by the set of points: \( \{(3,5), (2,6), (-5,3), (-7,1), (2,6)\} \)

2. Given \( f(x) = \frac{1}{2}x + 6 \) and its **domain** is described by the set \( \{6, -8, 4, 2\} \) what is the range?

3. Given \( f(x) = 2x - 1 \) and its **range** is described by the set \( \{5, -3, 1, 9\} \) what is the domain?

4. Describe the **domain** and **range** and label the x and y – intercepts on the graphs of the following graphed functions:

   - **A.**
     - **Domain:**
     - **Range:**

   - **B.**
     - **Domain:**
     - **Range:**

   - **C.**
     - **Domain:**
     - **Range:**

   - **D.**
     - **Domain:**
     - **Range:**

   - **E.**
     - **Domain:**
     - **Range:**

   - **F.**
     - **Domain:**
     - **Range:**
5. Determine which of the following variables are **DISCRETE** and which are **CONTINUOUS**.

a. The variable \( x \) represents the number of friends a person has on their Facebook account.

b. The variable \( x \) represents the number of questions a student missed on a test.

c. The variable \( x \) represents the amount of time it takes a student to complete the test.

d. The variable \( x \) represents the height of a student.

e. The variable \( x \) represents the value of the money each student has with them in class.

f. The variable \( x \) represents the weight of a package sent at the post office.

g. The variable \( x \) represents the number of packages delivered at a post office on a given day.

6. Describe the domain and range of each function below as **DISCRETE** or **CONTINUOUS**.

[Graphs of functions A, B, and C are shown with domains and ranges labeled.]

7. Find the \( x \) and \( y \)-intercepts of the following functions.

A. \( f(x) = \frac{1}{2}x + 6 \)  

B. \( g(x) = 3^x - 9 \)

C. \[
\begin{array}{c|c|c|c|c|c|c}
\hline
x & 2 & 4 & 6 & 8 & 10 \\
\hline
h(x) & 6 & 5 & 4 & 3 & 2 \\
\hline
\end{array}
\]

*assume \( h(x) \) is continuous and has a domain of all real numbers*
8. A postal company delivers packages based on their weight but will not ship anything over 50 pounds. The company charges $0.50 per pound to deliver the package anywhere in the United States. If we consider this situation a function where the number of pounds, x, is the independent variable and the cost in dollars, y, is the dependent variable determine the domain and range.

<table>
<thead>
<tr>
<th>Domain:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range:</td>
</tr>
</tbody>
</table>

9. A limousine company rents their limousine by the hour. The company charges $85 per hour. The minimum time is 2 hours and a maximum of 12 hours. If we consider this situation a function where the number of hours, x, is the independent variable and the cost in dollars of renting the limousine, y, is the dependent variable determine the domain and range.

<table>
<thead>
<tr>
<th>Domain:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range:</td>
</tr>
</tbody>
</table>

10. A student is growing a bean plant outside for a science project. The plants grow for 12 weeks before reaching their maximum height. The student consider the week she started growing the plant to be week 0 and then realized that the plant closely followed the function model \( h(x) = 1.5 \cdot (1.2)^x \), where \( x \) represents the number of weeks grown and \( h(x) \) represents the height of the plant in inches. Using the function model describe the appropriate domain and range.

<table>
<thead>
<tr>
<th>Domain:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range:</td>
</tr>
</tbody>
</table>

11. A vending company realized a relationship between the number of people present at the stadium during a Braves game and the number of hot dogs they sold. The minimum attendance due to players and support staff is 361 people and the maximum people that could be at the stadium is 86,436 people. The relationship that describes the number of hot dogs sold very closely followed the function model \( h(x) = 15 \cdot \sqrt{x} \) where \( x \) represents the number of people at the stadium and \( h(x) \) represents the number of hot dogs sold. What is the domain and range of the model?

<table>
<thead>
<tr>
<th>Domain:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range:</td>
</tr>
</tbody>
</table>

12. An author is selling autographed copies of his book at a stand in a bookstore in the mall and charging $12 per copy. The author brought a total of 40 books with him to sell at his stand. If the function \( p(x) = 12x \) represents the gross profit the author could make during the time he is sitting at the stand, determine the appropriate domain and range.

<table>
<thead>
<tr>
<th>Domain:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range:</td>
</tr>
</tbody>
</table>
1. Consider the following functions.
   a. Label each of the relative maximums and minimums of each function below and denote which are absolute extrema.
   b. Describe the intervals of increase and decrease
   c. Describe the end behavior.

I.
   [Graph of function f(x)]

   b. Increasing:
   [Graph showing increasing intervals]

   Decreasing:
   [Graph showing decreasing intervals]

   c. As \( x \to -\infty \), \( f(x) \to \)
   As \( x \to \infty \), \( f(x) \to \)

II.
   [Graph of function h(x)]

   b. Increasing:
   [Graph showing increasing intervals]

   Decreasing:
   [Graph showing decreasing intervals]

   c. As \( x \to -\infty \), \( f(x) \to \)
   As \( x \to \infty \), \( f(x) \to \)

III.
   [Graph of function g(x)]

   b. Increasing:
   [Graph showing increasing intervals]

   Decreasing:
   [Graph showing decreasing intervals]

   c. As \( x \to -\infty \), \( f(x) \to \)
   As \( x \to \infty \), \( f(x) \to \)

IV.
   [Graph of function with asymptote y = -2]

   b. Increasing:
   [Graph showing increasing intervals]

   Decreasing:
   [Graph showing decreasing intervals]

   c. As \( x \to -\infty \), \( f(x) \to \)
   As \( x \to \infty \), \( f(x) \to \)
2. Consider the following functions.
   a. Label each of the relative maximums and minimums of each function below and denote which are absolute extrema.
   b. Describe the intervals of increase, decrease, and when it is constant.
   c. Describe the end behavior.

3. A person is building a LEGO fence for his model farm. They have a total of 12 LEGO blocks that are each 3 cm in length. The builder was only using those 12 blocks to create a rectangle as shown below (and didn't need to have them meet at the corners. What are all of the possible configurations to build a rectangular border such that there is at least some area that is enclosed?

<table>
<thead>
<tr>
<th>Length</th>
<th>Width</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

   a. What is the maximum possible width in centimeters of one of the possible rectangles with at least some enclosed area?
   b. What is the minimum possible width in centimeters of one of the possible rectangles with at least some enclosed area?
   c. What is the maximum area that could be enclosed with the 14 LEGO blocks?
4. Which of the graphs below are always increasing or always decreasing?

5. At noon, a person begins to fill up a bath tub at a steady rate. The bath tub is completely filled with 50 gallons after 15 minutes. The person filling the tub had to let some water go down the drain because it was too full. After an additional 5 minutes the tub only has 20 gallons in it. The person decided the water got to cold and added 5 more gallons of hot water (for a total of 25 gallons) over the next 2 minutes to warm it up. Then, they decided they didn't have time for a bath and let all the water drain out over the next 4 minutes.

Create an appropriate graph that shows the volume of water in the bath tub in minutes after 12 noon. (you may assume all rates were constant as draining or filling began)

6. What is the average rate of change of the function \( f(x) = x^2 - 2 \) from \( x = 1 \) to \( x = 3 \)?

7. What is the average rate of change of the function \( g(x) = 2x - 1 \) from \( x = -1 \) to \( x = 2 \)?

8. What is the average rate of change of the function \( h(x) = 2^x - 3 \) from \( x = 2 \) to \( x = 3 \)?
10. What is the average rate of change of the function $t(x) = 2^x - 3$ from $x = 1$ to $x = 5$?

11. What is the average rate of change of the function $p(x) = \begin{cases} 
  x + 3, & x \leq -2 \\
  1, & -2 < x < 1 \\
  -x + 2, & x \geq 1 
\end{cases}$ shown in the graph below from $x = -3$ to $x = 4$?

12. Which linear function in the graph below is increasing at the fastest and which has the slowest rate?

13. Given the partial set of values of the linear functions $f(x)$ and $g(x)$, which function, $f(x)$ or $g(x)$, has the greater rate of change?

14. Given the partial set of values of the exponential functions $f(x)$ and $g(x)$, which function, $f(x)$ or $g(x)$, has the greater rate of change for all $x \geq 0$?

15. Consider the linear functions $f(x) = x^2 - 2$ and $g(x) = 2^x - 3$ which function has a greater average rate of change from $x = 1$ to $x = 3$?
Sec 2.12 – Functions

Transforms of Functions

Consider the following EQUATIONS, make a table, plot the points, and graph what you think the graph looks like.

1. \( f(x) = x^2 \) 
2. \( y = 2x^2 \) 
3. \( y = 5x^2 \) 
4. \( y = 0.2x^2 \)

<table>
<thead>
<tr>
<th>( x )</th>
<th>( y )</th>
<th>( x )</th>
<th>( y )</th>
<th>( x )</th>
<th>( y )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td></td>
<td>-2</td>
<td></td>
<td>-1.5</td>
<td></td>
</tr>
<tr>
<td>-2</td>
<td></td>
<td>-1.5</td>
<td></td>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>-1</td>
<td></td>
<td>-1</td>
<td></td>
<td>-0.5</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0.5</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1.5</td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td></td>
<td>1.5</td>
<td></td>
<td>4</td>
</tr>
</tbody>
</table>

5. What happens to the graph as the number in front of \( x^2 \) gets larger? Smaller?

<table>
<thead>
<tr>
<th>( x )</th>
<th>( y )</th>
<th>( x )</th>
<th>( y )</th>
<th>( x )</th>
<th>( y )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2</td>
<td></td>
<td>-3</td>
<td></td>
<td>-3</td>
<td></td>
</tr>
<tr>
<td>-1.5</td>
<td></td>
<td>-2</td>
<td></td>
<td>-2</td>
<td></td>
</tr>
<tr>
<td>-1</td>
<td></td>
<td>-1</td>
<td></td>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0.5</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0.5</td>
<td>1</td>
</tr>
<tr>
<td>1.5</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1.5</td>
<td>4</td>
</tr>
</tbody>
</table>

6. \( y = -2x^2 \) 
7. \( y = -0.5x^2 \) 
8. \( y = x^2 + 1 \) 
9. \( y = x^2 - 2 \)

<table>
<thead>
<tr>
<th>( x )</th>
<th>( y )</th>
<th>( x )</th>
<th>( y )</th>
<th>( x )</th>
<th>( y )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2</td>
<td></td>
<td>-3</td>
<td></td>
<td>-3</td>
<td></td>
</tr>
<tr>
<td>-1.5</td>
<td></td>
<td>-2</td>
<td></td>
<td>-2</td>
<td></td>
</tr>
<tr>
<td>-1</td>
<td></td>
<td>-1</td>
<td></td>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1.5</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1.5</td>
<td>4</td>
</tr>
</tbody>
</table>

10. What happens to the graph as the number in front of \( x^2 \) is negative?

11. What happens when you add a number or subtract a number from \( x^2 \)?
12. \( y = (x + 2)^2 \)

\[
\begin{array}{c|c}
 x & y \\
-3 & \ \\
-2 & \ \\
-1 & \ \\
0 & \ \\
1 & \ \\
2 & \ \\
3 & \ \\
\end{array}
\]

13. \( y = (x - 3)^2 \)

\[
\begin{array}{c|c}
 x & y \\
-3 & \ \\
-2 & \ \\
-1 & \ \\
0 & \ \\
1 & \ \\
2 & \ \\
3 & \ \\
\end{array}
\]

14. \( y = (x + 4)^2 \)

\[
\begin{array}{c|c}
 x & y \\
-5 & \ \\
-4 & \ \\
-3 & \ \\
-2 & \ \\
-1 & \ \\
0 & \ \\
1 & \ \\
\end{array}
\]

15. \( y = -2(x - 3)^2 + 2 \)

\[
\begin{array}{c|c}
 x & y \\
-1 & \ \\
0 & \ \\
1 & \ \\
2 & \ \\
3 & \ \\
4 & \ \\
5 & \ \\
\end{array}
\]

16. What happens when you add a number or subtract a number from \( x \) inside the parenthesis: ______

17. What is a possible equation for the following graphs:

\[
\begin{align*}
\text{Graph 1: } y &= (x \underline{\quad} \underline{\quad})^2 \\
\text{Graph 2: } y &= (x \underline{\quad} \underline{\quad})^2 \\
\text{Graph 3: } y &= (x \underline{\quad} \underline{\quad})^2 \\
\text{Graph 4: } y &= (x \underline{\quad} \underline{\quad})^2
\end{align*}
\]
18. Create a parabola that you think would describe the path of the basket ball through the goal.

\[ y = \_\_\_ (x \_\_\_ )^2 \_\_\_ \]

Graph it with your calculator to verify the parabola passes through the ball and hoop.

19. Consider the following points on the graph:

A. What would be the location of point A after it is reflected over the y-axis and translated down 3 units. Label the new point A''

B. What would be the location of point B after it is reflected over the x-axis, translated down 2 units, and translate right 1 unit. Label the new point B''

20. Given \( f(x) \), describe the transformations of \( f(-x) - 2 \)

21. Given \( f(x) \), describe the transformations of \( -\frac{1}{2} \cdot f(x - 3) + 4 \)
20. Consider the following parent graph \( f(x) \) at the right and create graphs for each of the following:

a. \( f(x - 4) + 3 \)

b. \( 2f(x) - 2 \)

c. \( \frac{1}{2}f(x + 1) \)

d. \( f(-x) + 1 \)
21. Given the graph of \( f(x) \) on the left, determine an equation for \( g(x) \) on the right in terms of \( f(x) \).

a. 

\[
g(x) = \quad \]

b. 

\[
g(x) = \quad \]

c. 

\[
g(x) = \quad \]

d. 

\[
g(x) = \quad \]
1. Consider the following functions.

\[
\begin{align*}
  f(x) &= 6x - 2 \\
  g(x) &= 3x \\
  h(x) &= 2^x + 3 \\
  p(x) &= 2
\end{align*}
\]

a. Determine \((f + g)(x)\)

b. Determine \((f + h)(x)\)

c. Determine \((g - f)(x)\)

d. Determine \((p \cdot g)(x)\)

e. Determine \((f \cdot g)(2)\)

f. Determine \(\left(\frac{f}{g}\right)(x)\)

2. Given the following partial set of values of function evaluate the following.

\[
\begin{array}{c|cccc}
  x & -1 & 0 & 1 & 2 & 3 \\
  \hline
  f(x) & 1 & 2 & 4 & 8 & 16 \\
  g(x) & -5 & -3 & -1 & 1 & 3 \\
\end{array}
\]

a. Determine \(f(1) - 2 \cdot g(2)\)

b. Determine \((f + g)(2)\)

3. Given the following partial set of values of function evaluate the following.

a. Determine \(f(4) + 2 \cdot g(1)\)
4. Consider the following functions.

\[
\begin{align*}
f(x) &= 6x - 2 \\
g(x) &= 3x \\
h(x) &= 2^x + 3 \\
p(x) &= 2
\end{align*}
\]

a. Determine \( (f \circ h)(1) \)  
b. Determine \( (g \circ f)(2) \)  

c. Determine \( (f \circ g)(x) \)  
d. Determine \( (g \circ h)(x) \)

5. Given the following partial set of values of function evaluate the following.

\[
\begin{array}{c|c|c|c|c|c}
  x & -1 & 0 & 1 & 2 & 3 \\
  f(x) & 1 & 2 & 4 & 8 & 16 \\
  g(x) & -5 & -3 & -1 & 1 & 3 \\
\end{array}
\]

a. Determine \( (f \circ g)(2) \)  
b. Determine \( (g \circ f)(0) \)

6. Given the following partial set of values of function evaluate the following.

a. Determine \( (f \circ g)(0) \)
1. Describe the symmetry of an EVEN function.

2. Describe the symmetry of an ODD function.

3. Describe each graph as EVEN, ODD, or NEITHER:

   - Graph 1: EVEN
   - Graph 2: ODD
   - Graph 3: NEITHER
   - Graph 4: EVEN
   - Graph 5: ODD
   - Graph 6: NEITHER
4. Describe the definition in function notation of every EVEN function.

5. Describe a definition in function notation of every ODD function.

6. Describe each function below as EVEN, ODD, or NEITHER
   a. \( f(x) = x^2 + 5 \) 
   b. \( g(x) = x^3 - 2x \)
   c. \( h(x) = x^5 - 4 \) 
   d. \( m(x) = x^4 + 3x^2 + 2 \)
   e. \( p(x) = x \) 
   f. \( q(x) = 3 \)

7. If \( f(2) = 3 \) and \( f(x) \) is an EVEN function what other point must be on the graph of \( f(x) \)?
   If \( g(2) = 3 \) and \( g(x) \) is an ODD function what other point must be on the graph of \( g(x) \)?

9. If the partially graphed function below is EVEN then finish what the rest of the graph should look like.

10. If the partially graphed function below is ODD then finish what the rest of the graph should look like.
ARITHMETIC SEQUENCES. Find the next few terms in the sequence and then find the requested term.

1) 2, 4, 6, 8, __, __, __ .......... Find $a_{42} =$ 

Determine the RECURSIVE DEFINITION:

Determine the EXPLICIT DEFINITION:

2) 5, 8, 11, 14, __, __, __ .......... Find $a_{33} =$ 

Determine the RECURSIVE DEFINITION:

Determine the EXPLICIT DEFINITION:

3) 10, 7, 4, 1, __, __, __ .......... Find $a_{29} =$ 

Determine the RECURSIVE DEFINITION:

Determine the EXPLICIT DEFINITION:
4) Josh was making a sequence pattern out of triangle pattern blocks.

If Josh continues this pattern, how many triangles will he need to make the 20th step of this pattern?

Functions can be used as explicit definitions for a sequence:
Consider the sequence: 4, 7, 10, 13, 16, 19, 22, 25, ....... The function \( f(x) = 4 + (x - 1)3 \) could be used to define the sequence where \( x = \) the term number. The domain would be \{1, 2, 3, 4, ....\} and the range would be \{4, 7, 10, 13, ....\}

5) Create a sequence based on the function: \( f(x) = 4x - 1 \)

6) Describe the **domain** and **range** of a function that might describe the sequence of \{14, 11, 8, 5, ....\}

7) Determine the **common difference** of the sequence and write a function that could be used to describe the sequence: \{14, 11, 8, 5, ....\}

8) Write a **recurrence relation** and an **explicit definition** for the following table:

<table>
<thead>
<tr>
<th>( n )</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>....</th>
</tr>
</thead>
<tbody>
<tr>
<td>( a_n )</td>
<td>5</td>
<td>7</td>
<td>9</td>
<td>11</td>
<td>13</td>
<td>....</td>
</tr>
</tbody>
</table>
9) Write a **recurrence relation** and an **explicit definition** for the following graph:

**RECURRENCE RELATION:**

**EXPLICIT DEFINITION:**

**GEOMETRIC SEQUENCES.** Find the next few terms in the sequence and then find the requested term.

10) 3, 6, 12, 24, _____, _____, _____ ........... Find $a_{24} =$

**RECURRENCE RELATION:**

**EXPLICIT DEFINITION:**

11) 2, -6, 18, -54, _____, _____, _____ ........... Find $a_{16} =$

**RECURRENCE RELATION:**

**EXPLICIT DEFINITION**
12) Create a sequence based on the function: \( f(x) = 5 \cdot 2^x \)

13) Write a recurrence relation and an explicit definition for the following table:

<table>
<thead>
<tr>
<th>( n )</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>......</th>
</tr>
</thead>
<tbody>
<tr>
<td>( a_n )</td>
<td>2</td>
<td>10</td>
<td>50</td>
<td>250</td>
<td>1250</td>
<td>......</td>
</tr>
</tbody>
</table>

RECURRENCE RELATION:

EXPLICIT DEFINITION:

14) Write a recurrence relation and an explicit definition for the following graph:

RECURRENCE RELATION:

EXPLICIT DEFINITION:

**SEQUENCES**

15) Given that a sequence is arithmetic, \( a_1 = 5 \), and the common difference is 4, find \( a_{37} \).

16) Given that a sequence is arithmetic, \( a_{52} = 161 \), and the common difference is 3, find \( a_1 \).

17) Given that a sequence is geometric, the first term is 1536, and the common ratio is \( \frac{1}{2} \), find the 7th term in the sequence.

18) Given that a sequence is geometric, \( a_{10} = 98415 \), and the common ratio is 3, find \( a_1 \).
19) The value of an ounce of silver is about $16 and over the last several years silver has increased in value by about 7%. How much should an ounce of silver be worth 20 years from now?

20) A person was having a graduation party and noticed that only 5 people were there after the first hour but grew in size by 61% every hour. If the size of the party grew this way for 6 hours, how many people would be at the party on the 6th hour?

21) Jessica is creating a drawing on her paper called a Binary Tree.

If Jessica continues drawing more and more branches, how many new branches would she need to draw on the 12th step?