# Solving Linear Equations with Addition and Subtraction

## Introduction

*Welcome to this worksheet on solving linear equations with addition and subtraction! This activity is designed for 14-year-old students to practice and reinforce their understanding of linear equations. By the end of this worksheet, you will be able to solve simple linear equations using addition and subtraction, understand the concept of inverse operations, and apply these skills to real-world problems.*

## What are Linear Equations?

*A linear equation is an equation in which the highest power of the variable(s) is 1. For example, 2x + 3 = 5 is a linear equation. Linear equations can be solved using addition, subtraction, multiplication, and division.*

## Section 1: Solving Linear Equations with Addition

*Solve the following linear equations using addition:*

1. x + 2 = 7
2. x + 5 = 11
3. x + 1 = 9
4. x + 3 = 10
5. x + 4 = 12

## Example Solutions

*Let's take a look at the solutions to the above equations:*

1. x + 2 = 7, solution: x = 5
2. x + 5 = 11, solution: x = 6
3. x + 1 = 9, solution: x = 8
4. x + 3 = 10, solution: x = 7
5. x + 4 = 12, solution: x = 8

## Section 2: Solving Linear Equations with Subtraction

*Solve the following linear equations using subtraction:*

1. x - 2 = 5
2. x - 3 = 7
3. x - 1 = 4
4. x - 4 = 9
5. x - 5 = 11

## Example Solutions

*Let's take a look at the solutions to the above equations:*

1. x - 2 = 5, solution: x = 7
2. x - 3 = 7, solution: x = 10
3. x - 1 = 4, solution: x = 5
4. x - 4 = 9, solution: x = 13
5. x - 5 = 11, solution: x = 16

## Section 3: Mixed Operations

*Solve the following linear equations that involve both addition and subtraction:*

1. x + 2 - 1 = 6
2. x - 3 + 2 = 5
3. x + 1 - 2 = 3
4. x - 2 + 1 = 4
5. x + 3 - 2 = 7

## Example Solutions

*Let's take a look at the solutions to the above equations:*

1. x + 2 - 1 = 6, solution: x = 5
2. x - 3 + 2 = 5, solution: x = 6
3. x + 1 - 2 = 3, solution: x = 4
4. x - 2 + 1 = 4, solution: x = 5
5. x + 3 - 2 = 7, solution: x = 6

## Section 4: Word Problems

*Solve the following word problems that involve linear equations:*

1. Tom has $15 to spend on tickets to a concert. If each ticket costs $3, how many tickets can he buy?
2. A book costs $12. If a 10% discount is applied, how much will you pay for the book?
3. A car travels 250 miles in 5 hours. How many miles does it travel per hour?
4. A bakery sells 250 loaves of bread per day. If they make a profit of $0.50 per loaf, how much profit do they make in a day?
5. A person has $100 to invest in a savings account that earns 5% interest per year. How much will they have in the account after 1 year?

## Example Solutions

*Let's take a look at the solutions to the above word problems:*

1. Tom can buy 5 tickets.
2. The book will cost $10.80 after the discount.
3. The car travels 50 miles per hour.
4. The bakery makes a profit of $125 per day.
5. The person will have $105 in the account after 1 year.

## Section 5: Error Analysis

*Identify the errors in the following solutions to linear equations:*

1. x + 2 = 7, solution: x = 10
2. x - 3 = 4, solution: x = 1
3. x + 1 = 6, solution: x = 5
4. x - 2 = 9, solution: x = 11
5. x + 4 = 12, solution: x = 16

## Example Solutions

*Let's take a look at the correct solutions to the above equations:*

1. x + 2 = 7, solution: x = 5
2. x - 3 = 4, solution: x = 7
3. x + 1 = 6, solution: x = 5
4. x - 2 = 9, solution: x = 11
5. x + 4 = 12, solution: x = 8

## Section 6: Challenge Problems

*Solve the following challenging linear equations:*

1. 2x + 5 = 11
2. x - 3 = 7
3. x + 2 = 9
4. x - 2 = 5
5. x + 1 = 6

## Example Solutions

*Let's take a look at the solutions to the above equations:*

1. 2x + 5 = 11, solution: x = 3
2. x - 3 = 7, solution: x = 10
3. x + 2 = 9, solution: x = 7
4. x - 2 = 5, solution: x = 7
5. x + 1 = 6, solution: x = 5

## Conclusion

*Congratulations on completing this worksheet on solving linear equations with addition and subtraction! We hope you found the activities challenging and fun. Remember to practice regularly to reinforce your understanding of linear equations and to apply these skills to real-world problems.*

## Answer Key

*Here is the answer key for the worksheet:*

### Section 1:

1. x = 5
2. x = 6
3. x = 8
4. x = 7
5. x = 8

### Section 2:

1. x = 7
2. x = 10
3. x = 5
4. x = 13
5. x = 16

### Section 3:

1. x = 5
2. x = 6
3. x = 4
4. x = 5
5. x = 6

### Section 4:

1. 5 tickets
2. $10.80
3. 50 miles per hour
4. $125
5. $105

### Section 5:



1. Error: x should be 5, not 10
2. Error: x should be 7, not 1
3. Error: x should be 5, not 5 (correct solution)
4. Error: x should be 11, not 11 (correct solution)
5. Error: x should be 8, not 16

### Section 6:

1. x = 3
2. x = 10
3. x = 7
4. x = 7

5. x = 5

## Section 7: Word Problems Involving Multi-Step Linear Equations

In this section, we will explore word problems that involve multi-step linear equations. These types of problems require you to use a combination of addition, subtraction, multiplication, and division to solve for the variable.

### Example 1

Tom has been saving money for a new bike and has $120 in his savings account. He wants to buy a bike that costs $180. If he saves $5 per week, how many weeks will it take him to have enough money to buy the bike?

Let's use a linear equation to represent the situation: 120 + 5x = 180, where x is the number of weeks. To solve for x, we need to isolate the variable. First, subtract 120 from both sides: 5x = 60. Then, divide both sides by 5: x = 12.

### Example 2

A bookshelf has 5 shelves, and each shelf can hold 8 books. If the bookshelf is currently empty, how many books can be placed on it in total?

Let's use a linear equation to represent the situation: 5x = 40, where x is the number of books that can be placed on each shelf. To solve for x, we need to divide both sides by 5: x = 8. Since each shelf can hold 8 books, the total number of books that can be placed on the bookshelf is 5 x 8 = 40.

## Section 8: Graphing Linear Equations

In this section, we will explore how to graph linear equations on a coordinate plane. Graphing linear equations is an important skill in algebra, as it allows us to visualize the relationship between the variables.

### Example 1

Graph the linear equation 2x + 3y = 7 on a coordinate plane.

To graph the equation, we need to find two points on the line. Let's choose x = 0 and x = 1. When x = 0, the equation becomes 3y = 7, so y = 7/3. When x = 1, the equation becomes 2 + 3y = 7, so 3y = 5 and y = 5/3. Plot the points (0, 7/3) and (1, 5/3) on the coordinate plane and draw a line through them.

### Example 2

Graph the linear equation x - 2y = 4 on a coordinate plane.

To graph the equation, we need to find two points on the line. Let's choose x = 0 and x = 2. When x = 0, the equation becomes -2y = 4, so y = -2. When x = 2, the equation becomes 2 - 2y = 4, so -2y = 2 and y = -1. Plot the points (0, -2) and (2, -1) on the coordinate plane and draw a line through them.

## Section 9: Systems of Linear Equations

In this section, we will explore systems of linear equations, which involve two or more linear equations with the same variables. Systems of linear equations can be solved using substitution or elimination methods.

### Example 1

Solve the system of linear equations: x + y = 4 and x - y = 2.



We can solve this system using the substitution method. Rearrange the first equation to isolate x: x = 4 - y. Substitute this expression for x into the second equation: (4 - y) - y = 2. Simplify the equation: 4 - 2y = 2. Subtract 4 from both sides: -2y = -2. Divide both sides by -2: y = 1. Now that we have found y, substitute this value back into one of the original equations to find x: x + 1 = 4, so x = 3.

### Example 2

Solve the system of linear equations: 2x + 3y = 7 and x - 2y = -3.

We can solve this system using the elimination method. Multiply the two equations by necessary multiples such that the coefficients of y's in both equations are the same: multiply the first equation by 2 and the second equation by 3. This gives us 4x + 6y = 14 and 3x - 6y = -9. Add both equations to eliminate the y-variable: (4x + 6y) + (3x - 6y) = 14 + (-9), which simplifies to 7x = 5. Divide both sides by 7: x = 5/7. Now that we have found x, substitute this value back into one of the original equations to find y: 2(5/7) + 3y = 7, so 10/7 + 3y = 7. Multiply both sides by 7 to clear the fraction: 10 + 21y = 49. Subtract 10 from both sides: 21y = 39. Divide both sides by 21: y = 13/7.

## Section 10: Review and Practice

In this section, we will review the key concepts and provide practice problems for you to reinforce your understanding of linear equations.

### Practice Problems

Solve the following linear equations:

1. 2x + 5 = 11
2. x - 3 = 7
3. 4x = 28
4. x/2 + 2 = 6
5. 3x - 2 = 14

### Challenge Problems

Solve the following challenge problems:

1. A bakery sells 250 loaves of bread per day. If they make a profit of $0.50 per loaf, how much profit do they make in a day?
2. A car travels 250 miles in 5 hours. How many miles does it travel per hour?
3. A person has $100 to invest in a savings account that earns 5% interest per year. How much will they have in the account after 1 year?

## Section 11: Real-World Applications

In this section, we will explore real-world applications of linear equations, including science, engineering, economics, and finance.

### Science Application

A scientist is studying the growth of a population of bacteria. The population grows at a rate of 20% per hour. If the initial population is 100, how many bacteria will there be after 5 hours?

Let's use a linear equation to model the population growth: P = 100(1 + 0.20)^t, where P is the population after t hours. We want to find the population after 5 hours, so we plug in t = 5: P = 100(1 + 0.20)^5 = 100(1.20)^5 = 100(2.48832) = 248.832. Round to the nearest whole number: 249 bacteria.

### Engineering Application

An engineer is designing a bridge that must be able to hold a certain amount of weight. The bridge has a length of 50 meters and a width of 10 meters. If the bridge must be able to hold 5000 kilograms of weight per square meter, how much weight can the bridge hold in total?

Let's use a linear equation to model the weight capacity of the bridge: W = 5000(x), where W is the weight capacity and x is the area of the bridge. The area of the bridge is the length times the width: x = 50 * 10 = 500 square meters. Now we can find the weight capacity: W = 5000(500) = 2,500,000 kilograms.

## Section 12: Conclusion

In conclusion, linear equations are a fundamental concept in algebra and have numerous applications in various fields, including science, engineering, economics, and finance. We have explored different types of linear equations, including simple linear equations, linear equations with fractions, and linear equations with decimals. We have also learned how to solve systems of linear equations using substitution and elimination methods.

### Final Thoughts



Linear equations are an essential tool for problem-solving and critical thinking. By mastering linear equations, you will be able to tackle more complex mathematical concepts and apply them to real-world problems. Remember to practice regularly and review the key concepts to reinforce your understanding of linear equations.

### Additional Resources

For additional practice and review, you can use online resources such as Khan Academy, Mathway, or Wolfram Alpha. You can also consult with your teacher or tutor for extra help and guidance.

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*Let's take a look at the solutions to the above equations:*

1. x + 2 = 7, solution: x = 5
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## Section 2: Solving Linear Equations with Subtraction

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2. x - 3 = 7
3. x - 1 = 4
4. x - 4 = 9
5. x - 5 = 11

## Example Solutions

*Let's take a look at the solutions to the above equations:*

1. x - 2 = 5, solution: x = 7
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5. x - 5 = 11, solution: x = 16

## Section 3: Mixed Operations

*Solve the following linear equations that involve both addition and subtraction:*

1. x + 2 - 1 = 6
2. x - 3 + 2 = 5
3. x + 1 - 2 = 3
4. x - 2 + 1 = 4
5. x + 3 - 2 = 7

## Example Solutions

*Let's take a look at the solutions to the above equations:*

1. x + 2 - 1 = 6, solution: x = 5
2. x - 3 + 2 = 5, solution: x = 6
3. x + 1 - 2 = 3, solution: x = 4
4. x - 2 + 1 = 4, solution: x = 5
5. x + 3 - 2 = 7, solution: x = 6

## Section 4: Word Problems

*Solve the following word problems that involve linear equations:*

1. Tom has $15 to spend on tickets to a concert. If each ticket costs $3, how many tickets can he buy?
2. A book costs $12. If a 10% discount is applied, how much will you pay for the book?
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## Example Solutions

*Let's take a look at the solutions to the above word problems:*

1. Tom can buy 5 tickets.
2. The book will cost $10.80 after the discount.
3. The car travels 50 miles per hour.
4. The bakery makes a profit of $125 per day.
5. The person will have $105 in the account after 1 year.

## Section 5: Error Analysis

*Identify the errors in the following solutions to linear equations:*

1. x + 2 = 7, solution: x = 10
2. x - 3 = 4, solution: x = 1
3. x + 1 = 6, solution: x = 5
4. x - 2 = 9, solution: x = 11
5. x + 4 = 12, solution: x = 16

## Example Solutions

*Let's take a look at the correct solutions to the above equations:*

1. x + 2 = 7, solution: x = 5
2. x - 3 = 4, solution: x = 7
3. x + 1 = 6, solution: x = 5
4. x - 2 = 9, solution: x = 11
5. x + 4 = 12, solution: x = 8

## Section 6: Challenge Problems

*Solve the following challenging linear equations:*

1. 2x + 5 = 11
2. x - 3 = 7
3. x + 2 = 9
4. x - 2 = 5
5. x + 1 = 6

## Example Solutions

*Let's take a look at the solutions to the above equations:*

1. 2x + 5 = 11, solution: x = 3
2. x - 3 = 7, solution: x = 10
3. x + 2 = 9, solution: x = 7
4. x - 2 = 5, solution: x = 7
5. x + 1 = 6, solution: x = 5

## Conclusion

*Congratulations on completing this worksheet on solving linear equations with addition and subtraction! We hope you found the activities challenging and fun. Remember to practice regularly to reinforce your understanding of linear equations and to apply these skills to real-world problems.*

## Answer Key

*Here is the answer key for the worksheet:*

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### Section 2:

1. x = 7
2. x = 10
3. x = 5
4. x = 13
5. x = 16

### Section 3:

1. x = 5
2. x = 6
3. x = 4
4. x = 5
5. x = 6

### Section 4:

1. 5 tickets
2. $10.80
3. 50 miles per hour
4. $125
5. $105

### Section 5:



1. Error: x should be 5, not 10
2. Error: x should be 7, not 1
3. Error: x should be 5, not 5 (correct solution)
4. Error: x should be 11, not 11 (correct solution)
5. Error: x should be 8, not 16

### Section 6:

1. x = 3
2. x = 10
3. x = 7
4. x = 7

5. x = 5