Chapter 1 Notes: Algebra 1
Solving Linear Equations

Algebra 1.1: Solving Simple Equations

Learning Outcomes:

I can solve linear equations using addition and subtraction.

I can solve linear equations using multiplication and division.

I can use linear equations to solve real-life problems.

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Review:

No calculators!

Simplify the expression.

1. $5 + (-15)$

2. $6 - 7$

3. $10 \bullet (-1)$

4. $\frac{-30}{2}$

5. -1×0

6. $4 - (-5)$

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Properties you have learned:

Commutative property for addition

Commutative property for multiplication

Associative property for addition

Associative property for multiplication

Distributive property

Additive identity property

Multiplicative identity property

Additive inverse property

Multiplicative inverse property

Multiplicative property of zero

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Review of mathematical properties:

Tell which property the statement illustrates.

1. $2 + 4 = 4 + 2$

2. $(3 \bullet 7)4 = 3(7 \bullet 4)$

3. $8 + 0 = 8$

4. $7 \bullet \frac{1}{7} = 1$

5. $4 \bullet 0 = 0$

6. $12(8 + 3) = 12 \bullet 8 + 12 \bullet 3$

Cumulative Warm Up

Core Concept

Addition Property of Equality

Words Adding the same number to each side of an equation produces an equivalent equation.

Algebra If $a = b$, then $a + c = b + c$.

Subtraction Property of Equality

Words Subtracting the same number from each side of an equation produces an equivalent equation.

Algebra If $a = b$, then $a - c = b - c$.

Solve each equation. Justify each step. Check your answer.

a. $x - 3 = -5$

b. $0.9 = y + 2.8$

Core Concept

Solve the equation. Justify each step. Check your solution.

1. n + 3 = − 7 2. $g-\frac{1}{3}=-\frac{2}{3}$ 3. −6.5 = p + 3.9

What about these?

4. 19 - x = 12 5. -3 - y = 14

Monitoring Progress 1-3

Core Concept

Multiplication Property of Equality

Words Multiplying each side of an equation by the same nonzero number produces an equivalent equation.

Algebra If $a = b$, then $a \cdot c = b \cdot c$, $c \neq 0$.

Division Property of Equality

Words Dividing each side of an equation by the same nonzero number produces an equivalent equation.

Algebra If $a = b$, then $a \div c = b \div c$, $c \neq 0$.

Solve each equation. Justify each step. Check your answer.

a. $-\frac{n}{5}=-3$ b. $\pi x = -2\pi$ c. 1.3z = 5.2

Core Concept

Solve the equation. Justify each step. Check your solution.

4. $\frac{y}{3} = -6$ 5. $9\pi = \pi x$ 6. $0.05w = 1.4$

Monitoring Progress 4-6

Core Concept

Four-Step Approach to Problem Solving

1. **Understand the Problem** What is the unknown? What information is being given? What is being asked?
2. **Make a Plan** This plan might involve one or more of the problem-solving strategies shown on the next page.
3. **Solve the Problem** Carry out your plan. Check that each step is correct.
4. **Look Back** Examine your solution. Check that your solution makes sense in the original statement of the problem.

Core Concept

In the 2012 Olympics, Usain Bolt won the 200-meter dash with a time of 19.32 seconds. Write and solve an equation to find his average speed to the nearest hundredth of a meter per second. **(d = r t)**

7. Suppose Usain Bolt ran 400 meters at the same average speed that he ran the 200 meters. How long would it take him to run 400 meters? Round your answer to the nearest hundredth of a second.

Monitoring Progress 7

Core Concept

Common Problem-Solving Strategies

Use a verbal model.	Guess, check, and revise.
Draw a diagram.	Sketch a graph or number line.
Write an equation.	Make a table.
Look for a pattern.	Make a list.
Work backward.	Break the problem into parts.

8. You thought the balance in your checking account was $68. When your bank statement arrives, you realize that you forgot to record a check. The bank statement lists your balance as $26. Write and solve an equation to find the amount of the check that you forgot to record.

Core Concept

- Describe in words how to solve a one-step equation.

- Solve for x: $-13.8 = x - 4.3$

Closure

Algebra 1.2: Solving Multi-step Equations

Learning Outcomes:

I can solve multi-step linear equations using inverse operations.

I can use multi-step linear equations to solve real-life problems.

I can use unit analysis to model real-life problems.

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Review:

Determine whether the given number is a solution to the equation.

1. $6x + 1 = 7x - 1; x = 2$
2. $5 - 4x = 2x^2 + x; x = 3$
3. $2y - \frac{2}{3} = 2; y = \frac{4}{3}$
4. $\frac{4u}{3} = -8; u = -6$

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Core Concept

Solving Multi-Step Equations

To solve a multi-step equation, simplify each side of the equation, if necessary. Then use inverse operations to isolate the variable.

Solve $2.5x - 13 = 2$. Check your solution.

Core Concept

Solve $-12 = 9x - 6x + 15$. Check your solution.

Solve the equation. Check your solution.

1. $-2n + 3 = 9$

2. $-21 = \frac{1}{2}c - 11$

3. $-2x - 10x + 12 = 18$

Example 2

1.2 notesheet continued ... day 2

Solving equations using the distributive property.

Solve $2(1 - x) + 3 = -8$. Check your solution.

One method: distribute

$2(1 - x) + 3 = -8$

Another method: isolate the parenthesis

$2(1 - x) + 3 = -8$

Example 3

Solve the equation. Check your solution.

4. $3(x + 1) + 6 = -9$

5. $15 = 5 + 4(2d - 3)$

6. $13 = -2(y - 4) + 3y$

7. $2x(5 - 3) - 3x = 5$

8. $-4(2m + 5) - 3m = 35$

9. $5(3 - x) + 2(3 - x) = 14$

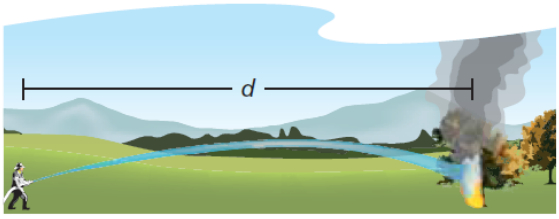
Monitoring Progress 4-9

Use the table to find the number of miles x you need to bike on Friday so that the mean number of miles biked per day is 5.

Day	Miles
Monday	3.5
Tuesday	5.5
Wednesday	0
Thursday	5
Friday	*x*

Example 4

10. The formula $d = \frac{1}{2}n + 26$ relates the nozzle pressure n (in pounds per square inch) of a fire hose and the maximum horizontal distance the water reachesd (in feet). How much pressure is needed to reach a fire 50 feet away?



Monitoring Progress 10

Your school's drama club charges $4 per person for admission to aplay. The club borrowed $400 to pay for costumes and props. After paying back the loan, the club has a profi t of $100. How many people attended the play?

11. You have 96 feet of fencing to enclose a rectangular pen for your dog. To provide sufficient running space for your dog to exercise, the pen should be three times as long as it is wide. Find the dimensions of the pen.

Example 5

Exit Ticket: Solve &x + 9 − 4x = 25. Check your solution.

Closure

Algebra 1.3: Solving Equations with Variables on Both Sides

Review:

Use the Distributive Property to simplify the expression.

1. $5(u - 5)$ **2.** $17(2 + n)$ **3.** $-5(e - 4)$

4. $-3(t + 7)$ **5.** $4(v - 6)$ **6.** $4(a + 5)$

Warm Up

Simplify the expression.

1. $-1 + (-1) + (-1)$
2. $(10)(-10)(-10)(10)$
3. $-6 - (-6)$
4. $\frac{300}{-3} \div \frac{300}{3}$
5. $4 + 4 - 4 + 4 - 4 + 4$
6. $2(10 - 2)(2 - 8)(6 - 2)(2 - 4)(2 - 2)$

Cumulative Warm Up 1-3

Learning Outcomes:

I can solve linear equations that have variables on both sides.

I can identify **special solutions** of linear equations.

I can use linear equations to solve real-life problems.

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Core Concept

Solving Equations with Variables on Both Sides

To solve an equation with variables on both sides, simplify one or both sides of the equation, if necessary. Then use inverse operations to collect the variable terms on one side, collect the constant terms on the other side, and isolate the variable.

Solve $10 - 4x = -9x$.

$$3(3x-4)=\frac{1}{4}(32x+56)$$

Check your solution.

Core Concept

Solve the equation. Check your solution.

1. $-2x = 3x + 10$

2. $\frac{1}{2}(6h-4)=-5h+1$

3. $-\frac{3}{4}(8n+12)=3(n-3)$

Monitoring Progress 1-3

Core Concept

Special Solutions of Linear Equations

Equations do not always have one solution. An equation that is true for all values of the variable is an **identity** and has *infinitely many solutions*. An equation that is not true for any value of the variable has *no solution*.

Solve each equation.

a. $3(5x + 2) = 15x$

b. $-2(4y + 1) = -8y - 2$

Core Concept

Solve the equation.

4. $4(1 - p) = -4p + 4$

5. $6m - m = \frac{5}{6}(6m - 10)$

6. $10k + 7 = -3 - 10k$

7. $3(2a - 2) = 2(3a - 3)$

Monitoring Progress 4-7

Concept Summary

Steps for Solving Linear Equations

Here are several steps you can use to solve a linear equation. Depending on the equation, you may not need to use some steps.

Step 1 Use the Distributive Property to remove any grouping symbols.

Step 2 Simplify the expression on each side of the equation.

Step 3 Collect the variable terms on one side of the equation and the constant terms on the other side.

Step 4 Isolate the variable. (Get the variable by itself)

Step 5 Check your solution.

Concept Summary

A boat leaves New Orleans and travels upstream on the MississippiRiver for 4 hours. The return trip takes only 2.8 hours because the boat travels 3 miles per hour faster downstream due to the current. How far does the boat travel upstream?

Example 4

8. A boat travels upstream on the Mississippi River for 3.5 hours. The return trip only takes 2.5 hours because the boat travels 2 miles per hour faster downstream due to the current. How far does the boat travel upstream?

Monitoring Progress 8

Reflect on your current understanding of solving equations.

• I Used to Think …

But Now I Know ....

• Exit Ticket: Solve $6 - 2x = 4x - 9$.

Closure

Algebra: 1.4 part 1

Absolute Value Equations

Learning Outcomes:

I can solve absolute value equations.

I can solve equations involving two absolute values.

I can identify special solutions of absolute value equations.

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Review from previous course:

| 5 | = _____ | -5 | = _____

| -72 | = _____ | 72 | = _____

Complete the statement with <, >, or =.

1. | -82 | ___ | 59 |

2. | -61 | ___ |61|

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What about this?

If | x | = 12, what does x equal? _____

| x | = 8 ... x = _____

| x | = -10 ... x = _____

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Core Concept

Properties of Absolute Value

Let a and b be real numbers. Then the following properties are true.

1. $|a| \geq 0$
2. $|-a| = |a|$
3. $|ab| = |a|\,|b|$
4. $\left|\frac{a}{b}\right| = \frac{|a|}{|b|}, b \neq 0$

Solving Absolute Value Equations

To solve $|ax + b| = c$ when $c \geq 0$, solve the related linear equations

$$ax + b = c \quad or \quad ax + b = -c.$$

When $c < 0$, the absolute value equation $|ax + b| = c$ has no solution because absolute value always indicates a number that is not negative.

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example: | x - 2 | = 3 Graph the solutions.

example: | 3x + 1 | = 5 Graph the solutions.

What about this? |3x + 1| = -5

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Solve the equation. Graph the solutions, if possible.

1. $|x| = 10$ 2. $|x - 1| = 4$ 3. $|3 + x| = -3$

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You may have to isolate the absolute value first ....

Solve $|3x + 9| - 10 = -4$.

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Solve the equation. Check your solutions.

4. $|x - 2| + 5 = 9$

5. $4|2x + 7| = 16$

6. $-2|5x - 1| - 3 = -11$

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Core Concept

Solving Equations with Two Absolute Values

To solve $|ax + b| = |cx + d|$, solve the related linear equations

$$ax + b = cx + d \quad or \quad ax + b = -(cx + d).$$

Solve: (a) $|3x - 4| = |x|$

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(b) $|x + 8| = |2x + 1|$

(c) $|4x - 10| = 2|3x + 1|$.

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Solve the equations. Check your solutions.

$3|x - 4| = |2x + 5|$

$|2x + 12| = 4x$

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Solve $|x + 5| = |x + 11|$.

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Algebra: 1.4 part 2

Review of 1.4 day 1: Solve the equations below .....

1. $|x - 2| + 5 = 9$

2. $3 \cdot |x - 4| = |2x + 5|$

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$$|x - 2| = 4$$

Graph the solutions.

What number is halfway between the two solutions? _____

How far away from the middle are each of the solutions? _____

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$$| x - 5 | = 3$$

Graph the solutions.

What number is halfway between the two solutions? _____

How far away from the middle are each of the solutions? _____

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Hhmm ... do you notice anything about those last two problems?

What about this? $| x + 2 | = 6$

Middle number?

Distance from middle to endpoints?

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Write an absolute value equation with these solutions.

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In a cheerleading competition, the minimum length of a routine is 4 minutes. The maximum length of a routine is 5 minutes. Write an absolute value equation that represents the minimum and maximum lengths. (Hint: graph the two solutions and see last two examples)

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For a poetry contest, the minimum length of a poem is 16 lines. The maximum length is 32 lines. Write an absolute value equation that represents the minimum and maximum lengths.

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Algebra 1.5: Rewriting Equations and Formulas

Review:

Solve the equation.

1. $y - 4 = 9$

2. $p + 5 = -6$

3. $6h = 18$

4. $\frac{x}{-2} = 5$

5. $4 - u = 2$

6. $-y = 2.3$

Warm Up

Learning Outcomes:

I can rewrite literal equations.

I can rewrite (and use) formulas for area.

I can rewrite (and use) other common formulas.

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Solve for y:

$3y + 14 = 9$

Solve the literal equation

$3y + 4x = 9$ for y.

Example 1

Solve the literal equation for *y*.

1. $3y - x = 9$

2. $2x - 2y = 5$

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Solve the formula for the indicated variable.

7. Area of a triangle: $A = \frac{1}{2}bh$; Solve for h.

Core Concept

Common Formulas

Temperature	F = degrees Fahrenheit, C = degrees Celsius $C = \frac{5}{9}(F - 32)$
Simple Interest	I = interest, P = principal, r = annual interest rate (decimal form), t = time (years) $I = Prt$
Distance	d = distance traveled, r = rate, t = time $d = rt$

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Solve the temperature formula for F.

9. A fever is generally considered to be a body temperature greater than 100°F. Your friend has a temperature of 37°C. Does your friend have a fever?

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Algebra 1: 1.5 Day 2

Review...

Solve the formula for the indicated variable.

8. Surface area of a cone: $S = \pi r^2 + \pi r\ell$; Solve for ℓ

What about this?

Solve the literal equation $y = 3x + 5xz$ for x.

Example 2

Solve the literal equation for *x*.

4. $y = 5x - 4x$ **5.** $2x + kx = m$ **6.** $3 + 5x - kx = y$

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The formula for the surface area S of a rectangular prism is

$S = 2\ell w + 2\ell h + 2wh$. Solve the formula for the length ℓ.

Example 3