

Adult Learning Academy
Pre-Algebra Workbook
UNIT 7: ALGEBRA



LEARNING OBJECTIVES

1. Variables and Expressions:

- Differentiate between constants and variables; represent variables with letters, and identify like terms
- Understand the difference between an expression and an equation
- Simplify and evaluate algebraic expressions involving variables; distribute and combine like terms
- Translate phrases into algebraic expressions and equations
- Write expressions to represent area and perimeter of rectangles

2. Equations:

- Use mathematical properties to solve basic linear equations involving a single variable
- Check solutions by plugging answers into the original equation and evaluating each side of the equation
- Solve one and two-step equations, including those involving fractions
- Solve multi-step equations, including those involving distribution, and variables on both sides of the equation
- Check solutions, by plugging answers into the original equations

3. Word Problems:

- Set up and solve word problems involving direct translations, including applications to the transportation industry

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UNIT 7 VIDEO & EXERCISE LIST



Topic	Website	Videos	Exercises
Variables and Expressions	www.khanacademy.org	Why All the Letters in Algebra?	Evaluating Expressions in 1 Var.
		What is a variable?	Combining Like Terms
		Why aren't we using the mult sign?	Comb. Like Terms w/Distribution
		Variables, Expressions, and equations	Writing Expressions
		Example: Evaluating an expression	
		Combining Like Terms	
		Comb. Like Terms & Distributive Prop	
		Combining Like Terms 1	
		Combining Like Terms 2	
Solving 1-step equations	www.khanacademy.org	Why do the same thing to both sides?	One-step Equation Intuition
		Simple equations	One-step Equations
		Representing a relationship w/ equation	One-step equations w/ multipli.
		One-step equation intuition	Equations w/ Var. on both sides
		1-step eq. intuition exercise intro	Worksheets: Solving Equations
		Solving one-step equations	
		Solving one-step equations 2	
		One-step Equations	
		Add/Sub the same thing from both sides	
		Intuition why we divide both sides	
Solving 2-step equations	www.khanacademy.org	Why we do the same... 2-step equations	Two-step equations
		Why we do the same... Multip-step	Multi-step equations w/ distrib.
		Two-step equations	Worksheets: Solving Equations
		Variables on both sides	
		Ex. 1 Variables on both sides	
		Ex. 2 Variables on both sides	
		Solving Equations w/ Distributive Prop	
		Ex. 1 Distributive Property to Simplify	
		Ex. 3 Distributive Property to Simplify	
Two-Step	http://www.youtube.com/watch?v=KBpNLjiv8pk		
Combining like terms	http://www.youtube.com/watch?v=fXD4DjSyoyo		

Topic	Website	Videos	Exercises
Variable on each side	http://www.youtube.com/watch?v=gQdH5PKWrPQ		
Distributive Property	http://www.youtube.com/watch?v=XfaWLVLfeJM		
Unit 7 Review Flashcards	www.stlcc.edu	Powerpoint on Blackboard	
Compass Review	http://www.hostos.cuny.edu/oaa/compass/pre-alg_prac7.htm		Radicals



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Pre-Algebra Workbook
7.1 SIMPLIFYING EXPRESSIONS



1. $3x + 2x$

10. $5(x - 2)$

2. $3x - 2x$

11. $3(x + 1)$

3. $2x - 3x$

12. $4(x - 1) + 3(x + 2)$

4. $x + x$

13. $7x + 5 - (2x + 1)$

5. $x - x$

14. $7x + 5 - (2x - 1)$

6. $x \cdot x$

15. $7x + 5(2x - 1)$

7. $x \div x$

16. $7x - 5(2x - 1)$

8. $x + y$

17. $7 - 5(2x - 1)$

9. $2x + 3y + 4x - y$

18. $7 - 5(2x + 1)$

1. $x + 7 = 15$

9. $-5 = x + 7$

2. $x - 13 = 20$

10. $5x = 3$

3. $8y = 48$

11. $\frac{1}{2}x = 10$

4. $\frac{a}{3} = 9$

12. $\frac{3}{4}x = 15$

5. $w + 100 = -200$

13. $5x = 5$

6. $x - 13 = -20$

14. $x - \frac{1}{2} = \frac{3}{2}$

7. $-8y = 48$

15. $-x = -7$

8. $\frac{a}{3} = -9$

16. $3x = 0$

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Pre-Algebra Workbook
7.3 SOLVING 2-STEP EQUATIONS



1. $2x + 1 = 7$

7. $7 = 5 + 2x$

2. $3x - 1 = 11$

8. $10 - 3x = 13$

3. $-2x + 1 = 9$

9. $\frac{x+4}{3} = 10$

4. $-5x - 1 = 9$

10. $\frac{x-7}{5} = 2$

5. $5 + 3x = 17$

11. $-4a + 2 = 2$

6. $7 - 3x = 13$

12. $\frac{w}{3} - 10 = 0$

1. $x + 3x = 12$

7. $3x = x + 4$

2. $5x - 3x + 2 = 12$

8. $4x = 2x + 10$

3. $3x - 5x + 2 = 12$

9. $-5x + 3 = -4x$

4. $5(x - 2) = 20$

10. $x - 5 = 2x$

5. $3(x + 1) = 15$

11. $2(x + 1) = x - 3$

6. $-2(x + 4) = 16$

12. $-2(x + 1) = 3x - 7$

EXPRESSION (SIMPLIFY if possible)

1. $x + x + x$

2. $3(x - 4)$

3. $5x - x$

4. $2 - x$

5. $x - 5 - 3$

6. $7 - 2(x + 1)$

7. $7 - 2(x - 1)$

8. $4x - \frac{1}{2}x$

EQUATION (SOLVE)

9. $x + x + x = 12$

10. $3(x - 4) = 5$

11. $5x - x = -20$

12. $2 - x = -6$

13. $x - 5 - 3 = 80$

14. $7 - 2(x + 1) = -1$

15. $7 - 2(x - 1) = -1$

16. $4x - \frac{1}{2}x = 7$

1. A plant had 10 leaves at the start of an experiment. How many leaves would it have if:
- a. ... it grew 2 new leaves? _____
 - b. ... it lost 2 leaves from the original? _____
 - c. ... it doubled its original number of leaves? _____
 - d. ... it lost half of its original leaves? _____
 - e. ... the number of leaves stayed the same? _____

Now we'll generalize to any number of leaves: a plant had X leaves at the start of the experiment. Match each algebraic expression with its description in words:

- | | |
|--|------------|
| f. The plant grew 2 new leaves. | $X - 2$ |
| g. The plant lost 2 leaves. | X |
| h. The plant doubled its number of leaves. | $X + 2$ |
| i. The plant has only half the number of leaves it started with. | $2X$ |
| j. The number of leaves stayed the same. | $X \div 2$ |

2. A computer has X megabytes of memory. Write an algebraic expression for the amount of memory compared to the original after each of the following situations:
- a. The computer used 50 megabytes of memory. _____
 - b. Deleting an application increased memory by 10 megabytes. _____
 - c. A new purchase doubled the memory. _____
 - d. Half of the original memory is left. _____
 - e. The computer has 30 megabytes less memory than originally. _____
 - f. The computer has 30 megabytes more memory than originally. _____

3. Aisha is A years old. Bakir is B years old. Write an algebraic expression for each description:
- Aisha's age next year: _____
 - Bakir's age two years ago: _____
 - Aisha's age in 10 years: _____
 - The sum of Aisha's and Bakir's ages: _____
 - Twice Aisha's age: _____
 - Half of Bakir's age: _____
 - The mean (average) of Aisha's and Bakir's ages: _____
 - If $A > B$, who is older? _____ How much older? _____

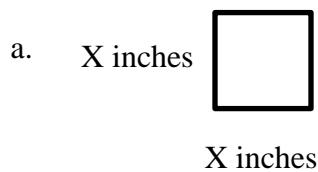
Using the variable A to represent Aisha's age and the variable B to represent Bakir's age, write an EQUATION for each description (use an $=$ sign!). Then solve the equation!

- In three years, Aisha will be 21. How old is she now?
- Five years ago, Bakir was 15. How old is he now?
- Twice Aisha's age is 48. How old is she?
- Half of Bakir's age is 12. How old is he?
- If you double Aisha's age and add 5, you get 35. How old is she?
- Aisha is three years older than Bakir. The sum of their ages is 23. How old are they?
- Aisha is twice as old as Bakir. The sum of their ages is 30. How old are they?

4. Write an equation and solve:

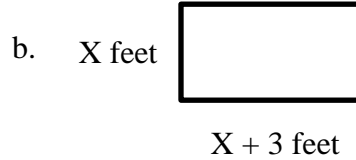
- a. Callie has 3 more patients to care for than Walter does. Walter has 5 patients. How many does Callie have?
- b. The perimeter of the rectangular laboratory is 170 feet. The length is 5 feet more than the width. What are the dimensions of the lab?
- c. The perimeter of the business office is 150 feet. The length is twice the width. What are the dimensions of the office?
- d. Insurance will pay half of the cost of an operation, after the patient pays the \$100 deductible. The operation costs \$1500. How much will insurance pay?

5. Write an expression for the perimeter and the area of each.



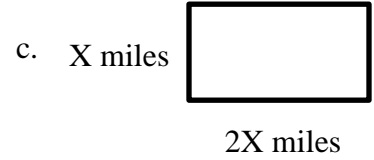
Perimeter: _____

Area: _____



Perimeter: _____

Area: _____



Perimeter: _____

Area: _____

7.1 Simplifying Expressions

1. $5x$
2. x
3. $-1x$ or $-x$
4. $2x$
5. 0
6. x^2
7. 1
8. $x + y$ (not like terms)
9. $6x + 2y$
10. $5x - 10$
11. $3x + 3$
12. $4x - 4 + 3x + 6$
 $= 7x + 2$
13. $7x + 5 - 2x - 1$
 $= 5x + 4$
14. $7x + 5 - 2x + 1$
 $= 5x + 6$
15. $7x + 10x - 5$
 $= 17x - 5$
16. $7x - 10x + 5$
 $= -3x + 5$
17. $7 - 10x + 5$
 $= 12 - 10x$
18. $7 - 10x - 5$
 $= 2 - 10x$

7.2 Solving One-Step Equations

1. $x + 7 - 7 = 15 - 7$
 $x = 15$
2. $x - 13 + 13 = 20 + 13$
 $x = 33$
3. $8y/8 = 48/8$ $y = 6$
4. $(\frac{a}{3})3 = (9)3$
 $a = 27$
5. $w + 100 - 100 = -200 - 100$
 $w = -300$
6. $x - 13 + 13 = -20 + 13$
 $x = -7$

7.2 Solving One-Step Equations (cont.)

7. $-8y/-8 = 48/-8$
 $y = -6$
8. $(\frac{a}{3})3 = (-9)3$
 $a = -27$
9. $-5 - 7 = x + 7 - 7$
 $-12 = x$ or $x = -12$
10. $5x/5 = 3/5$
 $x = 3/5$
11. $(\frac{1}{2}x)2/1 = (10)2/1$
 $x = 20$
12. $(\frac{3}{4}x)4/3 = (15)4/3$
 $x = 60/3 = 20$
13. $5x/5 = 5/5$ $x = 1$
14. $x - \frac{1}{2} + \frac{1}{2} = \frac{3}{2} + \frac{1}{2}$
 $x - \frac{1}{2} = 2$
 $x = \frac{4}{2} = 2$
15. $-x/-1 = -7/-1$ $x = 7$
16. $3x/3 = 0/3$ $x = 0$

7.3 Solving Two-Step Equations

1. $2x + 1 - 1 = 7 - 1$
 $2x = 6$
 $2x/2 = 6/2$ $x = 3$
2. $3x - 1 + 1 = 11 + 1$
 $3x = 12$
 $3x/3 = 12/3$
 $x = 4$
3. $-2x + 1 - 1 = 9 - 1$
 $-2x = 8$
 $-2x/-2 = 8/-2$
 $x = -4$
4. $-5x - 1 + 1 = 9 + 1$
 $-5x = 10$
 $-5x/-5 = 10/-5$
 $x = -2$
5. $5 + 3x - 5 = 17 - 5$
 $3x = 12$
 $3x/3 = 12/3$
 $x = 4$

7.3 Solving Two-Step Equations (cont.)

6. $7 - 3x - 7 = 13 - 7$

$$-3x = 6$$

$$-3x/-3 = 6/-3$$

$$x = -2$$

7. $7 - 5 = 5 + 2x - 5$

$$2 = 2x$$

$$2/2 = 2x/2$$

$$1 = x \text{ or } x = 1$$

8. $10 - 3x - 10 = 13 - 10$

$$-3x = 3$$

$$-3x/-3 = 3/-3$$

$$x = -1$$

9. $(\frac{x+4}{3})3 = (10)3$

$$x + 4 - 4 = 30 - 4$$

$$x = 26$$

10. $(\frac{x-7}{5})5 = (2)5$

$$x - 7 + 7 = 10 + 7$$

$$x = 17$$

11. $-4a + 2 - 2 = 2 - 2$

$$-4a = 0$$

$$-4a/-4 = 0/-4$$

$$a = 0$$

12. $\frac{w}{3} - 10 + 10 = 0 + 10$

$$(\frac{w}{3})3 = (10)3$$

$$w = 30$$

7.4 Solving Multi-Step Equations

1. $x + 3x = 12$

$$4x = 12$$

$$4x/4 = 12/4$$

$$x = 3$$

2. $5x - 3x + 2 = 12$

$$2x + 2 = 12$$

$$2x + 2 - 2 = 12 - 2$$

$$2x = 10$$

$$2x/2 = 10/2$$

$$x = 5$$

3. $3x - 5x + 2 = 12$

$$-2x + 2 = 12$$

$$-2x + 2 - 2 = 12 - 2$$

$$-2x = 10$$

$$-2x/-2 = 10/-2$$

$$x = -5$$

7.4 Solving Multi-Step Equations (cont.)

4. $5(x - 2) = 20$

$$5x - 10 = 20$$

$$5x - 10 + 10 = 20 + 10$$

$$5x = 30$$

$$5x/5 = 30/5$$

$$x = 6$$

5. $3(x + 1) = 15$

$$3x + 3 = 15$$

$$3x + 3 - 3 = 15 - 3$$

$$3x = 12$$

$$3x/3 = 12/3$$

$$x = 4$$

6. $-2(x + 4) = 16$

$$-2x - 8 = 16$$

$$-2x - 8 + 8 = 16 + 8$$

$$-2x = 24$$

$$-2x/-2 = 24/-2$$

$$x = -12$$

7. $3x - x = x + 4 - x$

$$2x = 4$$

$$2x/2 = 4/2$$

$$x = 2$$

8. $4x - 2x = 2x + 10 - 2x$

$$2x = 10$$

$$2x/2 = 10/2$$

$$x = 5$$

9. $-5x + 3 + 5x = -4x + 5x$

$$3 = 1x \text{ or } x = 3$$

10. $x - 5 - x = 2x - x$

$$-5 = x \text{ or } x = -5$$

11. $2(x + 1) = x - 3$

$$2x + 2 = x - 3$$

$$2x + 2 - 2 = x - 3 - 2$$

$$2x = x - 5$$

$$2x - x = x - 5 - x$$

$$x = -5$$

12. $-2(x + 1) = 3x - 7$

$$-2x - 2 = 3x - 7$$

$$-2x - 2 + 7 = 3x - 7 + 7$$

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

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

$$5 = 5x$$

$$5/5 = 5x/5$$

$$1 = x \text{ or } x = 1$$

7.5 Expressions & Equations

1. $3x$
2. $3x - 12$
3. $4x$
4. $2 - x$ (not like terms)
5. $x - 8$
6. $7 - 2x - 2$
 $= 5 - 2x$
7. $7 - 2x + 2$
 $= 9 - 2x$
8. $3\frac{1}{2}x$ or $3.5x$
9. $3x = 12$
 $x = 12/3 = 4$
10. $3x - 12 = 5$
 $3x = 17$
 $x = 17/3 = 5\frac{2}{3}$ or 5.666
11. $4x = -20$
 $x = -20/4 = -5$
12. $-x = -8$
 $-x/-1 = -8/-1$ so $x = 8$
13. $x - 8 = 80$ so $x = 88$
14. $7 - 2x - 2 = -1$
 $5 - 2x = -1$
 $-2x = -6$
 $x = -6/-2 = 3$
15. $7 - 2x + 2 = -1$
 $9 - 2x = -1$
 $-2x = -10$
 $x = -10/-2 = 5$
16. $3.5x = 7$
 $x = 7/3.5 = 2$

7.6 Career Applications: STEM

- 1a. 12
- 1b. 8
- 1c. 20
- 1d. 5
- 1e. 10
- 1f. $X + 2$
- 1g. $X - 2$
- 1h. $2X$
- 1i. $X/2$
- 1j. X

7.6 Career Applications: STEM (cont.)

- 2a. $x - 50$
- 2b. $x + 10$
- 2c. $2x$
- 2d. $x/2$ or $.5x$ or $1/2x$
- 2e. $x - 30$
- 2f. $x + 30$

- 3a. $A + 1$
- 3b. $B - 2$
- 3c. $A + 10$
- 3d. $A + B$
- 3e. $2A$
- 3f. $B/2$
- 3g. $(A + B)/2$ or $1/2(A + B)$
- 3h. Aisha; $A - B$ years
- 3i. $A + 3 = 21$ so $A = 18$ years old
- 3j. $B - 5 = 15$ so $B = 20$ years old
- 3k. $2A = 48$ so $A = 24$ years old
- 3l. $B/2 = 12$ so $B = 24$ years old
- 3m. $2A + 5 = 35$ so $A = 15$ years old
- 3n. $A + B = 23$ and $A = B + 3$
so $(B + 3) + B = 23$
 $B = 10$ years and $A = 10 + 3 = 13$ years
- 3o. $A + B = 30$ and $A = 2B$
so $2B + B = 30$
 $B = 10$ years and $A = 2(10) = 20$ years

- 4a. let $x =$ Callie's # of patients
 $x = 5 + 3$
 $x = 8$ so Callie has 8 patients
- 4b. Let width = w and length = $w + 5$
perimeter = sum of all four sides
so $w + (w + 5) + w + (w + 5) = 170$
 $4w + 10 = 170$ $4w = 160$ so $w = 40$
width = 40 feet and length = $40 + 5 = 45$ feet
- 4b. Let width = w and length = $2w$
perimeter = sum of all four sides
so $w + 2w + w + 2w = 150$
 $6w = 150$ so $w = 25$
width = 25 feet and length = $2(25) = 50$ feet
- 4d. Let $x =$ the amount insurance will pay
 $x = .5(1500 - 100)$
 $x = .5(1400)$
 $x = \$700$

7.6 Career Applications: STEM (cont.)

- 5a. Perimeter = $4x$ inches Area = x^2 square inches
5b. Perimeter = $4x + 6$ feet Area = $x^2 + 3x$ square feet
5c. Perimeter = $6x$ miles Area = $2x^2$ square miles



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