



ADULT LEARNING ACADEMY

MATH Algebra I



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Edited by Nicole McMeans St. Louis Community College Second Version: 06/01/2015



Adult Learning Academy Elementary Algebra Workbook



ALA Elementary Algebra Math Progress

Name:	Date started: _	
	DATE	SCORE
Module 1: Variables, Expressions, Equations, and Inequalities		
Module 2: Applications of Linear Equations, Function Notation		
Module 3: Rectangular Coordinate System, Graphs of Linear Equations, Slope		
Module 4: Equations of Lines, Graphs of Linear Inequalities, Solving Systems by Graphing		
Module 5: Integer Exponents and Laws, Scientific Notation, Polynomials and Operations		
Module 6: Factoring Polynomials, Solving Quadratic Equations by Factoring		
Retake Compass Test		



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MODULE 1: EXPRESSIONS, EQUATIONS, AND INEQUALITIES Learning Objectives

By the time you finish this module, you should be able to:

- □ Review topic: Add, subtract, multiply, and divide fractions and integers (neg, pos)
- □ Write and simplify algebraic expressions using variables
- □ Recognize like terms; add and subtract them appropriately
- Distinguish between expressions to be simplified and equations to be solved
- □ Solve linear equations with one variable, including multi-step equations, equations requiring use of the distributive property, equations containing fractions, and equations with variables on both sides
- □ Solve linear inequalities in one variable and graph their solutions on a number line, using brackets, parentheses, the infinity symbol, set-builder notation, and interval notation appropriately. Also solve compound inequalities.

IMPORTANT INFORMATION FROM MODULE 1:

Birthday song: You must have common denominators... to ADD or SUBTRACT... Birthday song: You must have like terms... to ADD or SUBTRACT...

Pos + Pos = Pos	Neg + Neg = NEG ((watch this one!)	Pos + Neg = it depends!
To subtract a number	r, ADD its OPPOSITH	Ŧ	
Pos x Pos = Pos	$Neg \times Neg = Pos$	Pos x Neg = Neg	Neg x $Pos = Neg$
$Pos \div Pos = pos$	$Neg \div Neg = Pos$	$Pos \div Neg = Neg$	$Neg \div Pos = Neg$

You can SIMPLIFY expressions, but not solve them.

You can SOLVE equations (they have an = sign!). To SOLVE an equation or inequality means to find the value(s) of the variable that makes the equation or inequality true.

Golden Rule of Algebra: Whatever you do to one side of an equation or inequality, you MUST do to the other side!

To undo addition, subtract. To undo subtraction, add. To undo multiplication, divide. To undo division, multiply.

You can check the solution to any equation by plugging the value for the variable back into the original equation and see if it *satisfies* the equation.

If an equation has NO solution, it is called a CONTRADICTION. If ALL REAL NUMBERS are solutions to an equation, it is called an IDENTITY.

Use brackets [] or a closed circle for \geq or \leq . Use Parentheses ("Don't Touch Me!") or an open circle for < or >.

When you multiply or divide both sides of an inequality by a negative number, you must FLIP the inequality symbol.



Adult Learning Academy Elementary Algebra Workbook MODULE 1 VIDEO & EXERCISE LIST



Торіс	Website	Videos	Exercises
Review Fractions, Integers	www.stlcc.edu	Blackboard Review Flashcards: Fractions	
		Blackboard Review Flashcards: Integers	
If you need more review of frac	tions and integers, see the revi	iew videos and exercises.	
Variables and Expressions	www.khanacademy.org	The Beauty of Algebra	
		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	
		Equation Special Cases	
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	

Торіс	Website	Videos	Exercises
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/w	atch?v=KBpNLjiv8pk	
Combining like terms	http://www.youtube.com/w	atch?v=fXD4DjSyoyo	
Variable on each side	http://www.youtube.com/w	http://www.youtube.com/watch?v=gQdH5PKWrPQ	
Distributive Property	http://www.youtube.com/watch?v=XfaWLVLfeJM		
Solving Inequalities	www.khanacademy.org	Inequalities on a Number Line	Inequalities on a Number Line
		Inequalities Using Addition and Subtr.	One-Step Inequalities
		Inequalities Using Mult and Division	Multi-Step Linear Inequalities
		One-Step Inequalities	
		One-Step Inequalities 2	
		Solving Inequalities	
		Multi-Step Inequalities	
		Multi-Step Inequalities 2	
		Multi-Step Inequalities 3	
		Writing and Using Inequalities 3	
		Compound Inequalities 3	
	www.stlcc.edu	Inequalities Powerpoint on Blackboard	
Module 1 Review	www.stlcc.edu	Powerpoint on Blackboard	
Compass Review	http://www.hostos.cuny.edu	http://www.hostos.cuny.edu/oaa/compass/algebra_prac5.htm	

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1.1 PRE-ALGEBRA REVIEW: DO YOU REMEMBER FRACTIONS?

1. Write a fraction that is equal to $\frac{1}{2}$:	10. $\frac{4}{5} \cdot \frac{15}{9}$
2. Write a fraction that is equal to 1:	
3. Write a fraction that is greater than 1:	11. $\frac{4}{5} \div \frac{8}{15}$
4. Write a fraction that is less than $\frac{1}{5}$:	12. $3\frac{7}{9} - 1\frac{1}{6}$
5. Write a fraction that is equal to 0:	
6. What is half of $\frac{2}{3}$?	13. $5\frac{1}{2} \cdot 2\frac{4}{5}$
7. Write a fraction that is UNDEFINED:	(a) ²
Simplify:	14. $\left(\frac{3}{4}\right)^2$
8. $\frac{4}{10} + \frac{3}{10}$	
	15. $\frac{15}{3} + \frac{9}{16} \left(1\frac{1}{3}\right)^2$
9. $\frac{3}{10} + \frac{2}{15}$	



Adult Learning Academy Elementary Algebra Workbook 1.2 PRE-ALGEBRA REVIEW: FRACTIONS VIDEO & EXERCISE LIST



Торіс	Website	Videos	Exercises
Understanding Fractions	www.khanacademy.org	Numerator, Denominator of a Fraction	Recognizing Fractions 0.5
		Identifying Fraction Parts	Recognizing Fractions
			Fractions on the Number line 1
			Fraction Word Problems 1
Equivalent Fractions	www.khanacademy.org	Equivalent Fractions	Simplifying Fractions
		Equivalent Fractions Example	Comparing Fractions 1
		Comparing Fractions	Equivalent Fractions
		Fractions in Lowest Terms	Equivalent Fractions 2
		Finding Common Denominators	Comparing Fractions 2
		Ordering Fractions	
		Comparing Fractions 2	
Add, Subtract Fractions	www.khanacademy.org	Adding Fractions w/ Like Denominators	Adding Frac. w/ Common Denom
		Subtracting Fractions	Subtract Frac. w/Common Denom
		Adding and Subtracting Fractions	Adding Fractions
		Adding Fractions w/ unlike denom	Subtracting Fractions
		Adding Fractions Ex. 1	Adding and Subtracting Fractions
Multiplying Fractions	www.khanacademy.org	Multiplying Fractions	Multiplying Fractions 0.5
		Multiplying Fractions Word Problem	Multip. Fractions Word Problems
Dividing Fractions	www.khanacademy.org	Dividing Fractions	Dividing Fractions 0.5
		Dividing Fractions Example	Dividing Fractions Word Problems
		Dividing Fractions Word Problems	

Торіс	Website	Videos	Exercises
Mixed Numbers and	www.khanacademy.org	Proper and Improper Fractions	Fractions on the Number Line 2
Improper Fractions		Comparing Imp Frac & Mixed Numbers	Comparing Imp Frac & Mixed No.
		Mixed Numbers and Improper Frac.	Converting Mixed Numbers & I.F.
		Changing a Mixed Number to Imp Frac	
		Changing an Imp Fract to a Mixed No.	
		Ordering Imp. Fractions & Mixed No.	
Mixed Number Add & Sub	www.khanacademy.org	Adding Mixed Numbers	Add/Subt Mixed Numbers 0.5
		Adding Mixed Nos. w/ Unlike Denom	Add/Subt Mixed Numbers 1
		Adding Mixed Nos. Word Problem	
		Subtracting Mixed Numbers	
		Subtracting Mixed Numbers 2	
		Subtracting Mixed Numbers Word Prob	
Mixed Number Mult & Div		Multiplying Fractions and Mixed Nos.	Multiplying Mixed Numbers 1
		Multiplying Mixed Numbers	
		Dividing Mixed Numbers	
		Dividing Mixed Numbers and Fractions	



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1.3 PRE-ALGEBRA REVIEW: DO YOU REMEMBER INTEGERS?

SIN 1.	MPLIFY: -5 + -3	10. 10 ÷ (-2)
2.	-5 + 3	1110 ÷ (-2)
3.	3 – 5	123(5 – 4)
4.	-3 - 5	135 ²
5.	-3 – (-5)	14. (-5) ²
6.	-5 - (-3)	15. $7 - 6(2 - 3)^3$
7.	-5 - 3	16. $14 \div 7(-5+4)^2$
8.	-5(-2)	17. <u></u>
9.	-5(2)	-12



Adult Learning Academy Elementary Algebra Workbook 1.4 PRE-ALGEBRA REVIEW: INTEGERS VIDEO & EXERCISE LIST



Торіс	Website	Videos	Exercises
Negative Number Basics	ber Basics www.khanacademy.org Negative Numbers Introduction		Number Line 2
		Ordering Negative Numbers	Ordering Negative Numbers
			Number Line 3
Adding Integers	www.khanaadamy.org	Example: Adding Nagative Numbers	Adding Nagative Numbers
Adding Integers	www.khanacademy.org	Example. Adding integers w/ diff. signs	Adding Negative Numbers
		Ex: Adding integers w/ diff. signs	
Subtracting Integers	www.khanacademy.org	Why subtracting neg is adding positive	Adding and Subtracting Neg Num.
	www.stlcc.edu	Subtracting Integers PPT on Blackboard	
		Adding/Sub Negative Numbers	
Maltinlain - Disidin - No - #		Makintaine Dee end Nee Neucleur	Malt/Dis Na atiss Namh an
Multiplying/Dividing Neg #	www.knanacademy.org	Why Nee y Nee is positive	Nult/Div Negative Numbers
		Dividing Pos and Nog Numbers	Negative Nulliber word Probs
		Example: Mult #'s w/ diff signs	
		Mult and Div Negative numbers	
		What and DIV Regative numbers	
Absolute Value	www.khanacademy.org	Absolute Value and Number Lines	Finding Absolute Values
		Absolute Value 1	Comparing Absolute Values
		Absolute Value of Integers	
		Comparing Absolute Values	
Exponents	www.khanacademy.org	Level 1 Exponents	Positive and Zero Exponents
		Understanding Exponents 2	
Scientific Notation	www.khanacademy.org	Scientific Notation	Scientific Notation
		Scientific Notation 1	
Square Roots	www.khanacademy.org	Understanding Square Roots	Square Roots



Adult Learning Academy Elementary Algebra Workbook 1.5 PRACTICE WITH FRACTIONS AND INTEGERS



Simplify the expression in each box and color any that match the same color.

There should be three of each answer!

$\frac{4}{5} + \frac{3}{10}$	-1 – 1	$\frac{3}{6} - \frac{4}{8}$	6 ÷ 0	$\frac{2}{1}$
(-5)(4)	$\frac{3}{6} + \frac{5}{10}$	Half of ½	-3 ²	Double 10.
-32 + 32	$(-10)^2$	$\frac{47}{0}$	$\frac{33}{30}$	Half of $\frac{5}{3}$
10 - (-2)	$\frac{-10}{2}$	$\frac{-50}{-25}$	-15 – 5	7 + (-6)
-2-7	$\frac{7}{14} \div 2$	$\frac{1}{2} + \frac{1}{3}$	$\frac{0}{47}$	$\frac{45}{54}$
15 – (-5)	$5\frac{1}{2} \div 5$	$3\frac{1}{2} \cdot 1\frac{1}{2}$	-4 - 1	-5 + 3
$\frac{15}{37} \cdot \frac{37}{15}$	-6 ÷ 3	10 ²	-11 + 2	3-5
$5\frac{1}{4}$	$9 \div (3 - 3)$	(-3)(-4)	$\frac{3}{2} \div \frac{2}{7}$	0 - 5
$\frac{5}{2} \cdot \frac{24}{5}$	(-4)(-5)	$50 \div \frac{1}{2}$	$-12 \cdot \frac{5}{3}$.25

	St. Louis Community College	Adult Learning Academy Elementary Algebra Workbook 1.6 SIMPLIFYING EXPRESSIONS	MoSI
1.	5x + 3x	10. $5(x-2)$	
2.	5x – 3x	11. $3(x + 1)$	
3.	3x – 5x	12. $5(x-1) + 3(x+2)$	
4.	x + x	13. $3x + 5 - (2x + 1)$	
5.	X – X	14. $3x + 5 - (2x - 1)$	
6.	X • X	15. $3x + 5(2x - 1)$	
7.	$\mathbf{x} \div \mathbf{x}$	16. $3x - 5(2x - 1)$	
8.	x + y	17. $7 - 3(2x - 1)$	
9.	3x + 3y + 5x - y	18. $7 - 3(2x + 1)$	

<u>~</u>	St. Louis Community College	Adult Learning Aca Elementary Algebra W 1.7 SOLVING 1-STEP EQ	demy orkbook UATIONS
1.	x + 3 = 15	9.	-5 = x + 4
2.	x-4 = 20	10.	5x = 7
3.	6y = 48	11.	י∕₂ x = 12
4.	$\frac{a}{3} = 12$	12.	³ ⁄ ₄ x = 18
5.	w + 100 = -300	13.	7x = 7
б.	x – 12 = –20	14.	$\mathbf{X} - \frac{1}{2} = \frac{3}{2}$
7.	-6y = 48	15.	-x = -7
8.	$\frac{a}{3} = -9$	16.	$5\mathbf{x} = 0$

	St. Louis Community College	Adult Learning Academy Elementary Algebra Workbook 1.8 SOLVING 2-STEP EQUATIONS
1.	2x + 1 = 7	7. $7 = 5 + 2x$
2.	3x - 1 = 11	8. $10 - 3x = 13$
3.	-2x + 1 = 9	$9. \qquad \frac{x+4}{3} = 10$
4.	-5x – 1 = 9	10. $\frac{x-7}{5} = 2$
5.	5 + 3x = 17	11. $-4a + 2 = 2$
6.	7 - 3x = 13	12. $\frac{w}{3} - 10 = 0$

ſ	St. Louis Community College	Adult Learning Ac Elementary Algebra V 1.9 SOLVING MULTI-STE	cademy Workbook P EQUATIONS
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

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Adult Learning Academy Elementary Algebra Workbook 1.10 EXPRESSIONS & EQUATIONS



	EXPRESSION (SIMPLIFY if possible)	EQUATION (SOLVE)
1.	x + x + x	9. $x + x + x = 12$
2.	3(x - 4)	10. $3(x-4) = 5$
3.	5x - x	11. $5x - x = -20$
4.	2 – x	12. $2 - x = -6$
5.	x - 5 - 3	13. $x - 5 - 3 = 80$
6.	7 - 2(x + 1)	14. $7 - 2(x + 1) = -1$
7.	7 - 2(x - 1)	15. $7 - 2(x - 1) = -1$
8.	4x – ½ x	16. $4x - \frac{1}{2}x = 7$





$\mathbf{x} + \mathbf{4} = \mathbf{x}$

When we subtract x from both sides of this equation, we get 4 = 0. The variables have disappeared, and we are left with a FALSE statement. There is NO solution—we have a **CONTRADICTION**!

3x - 5 = 3x + 1

When we subtract 3x from both sides of this equation, we get -5 = 1 (or some other false statement with no variables in it). This is also a CONTRADICTION and has no solution!

4x + 5 = 4x + 5

If we subtract 4x from both sides of this equation, we get 5 = 5. The variables have disappeared, but this time the statement we have left is TRUE! This is called an **IDENTITY**, and ALL real numbers are solutions.

3(x-6) = 3x - 18

If you try solving this equation, you lose all your variables, and the remaining statement is true. This is also an identity. It doesn't matter what value we put in for x, the statement is always true!

NOTE: These special equations (contradictions and identities) only come up once in a while. Most equations are what we call "**Conditional**" they have a solution, but not every number in the world is a solution.

What type of equation is it--Identity? Contradiction? Conditional?

1. $3x + 5 = 5$	
2. $3x + 5 = 3x + 5$	
3. $3x + 5 = 3x + 7$	
4. $3(x+2) = 3x + 6$	
5. $3(x+2) = 3x + 5$	
6. $3(x+2) = 2x + 5$	
7. x = x	
8. $x = x - 1$	
9. $4x + 1 = x - 2$	
10. $x + x = 2x$	
11. $x + x = 3x$	
12. $x + x = 6$	
13. $x + x = x + 1$	
14. $x + 1 = x + 2$	
15. $x + 1 = 6$	



c. Interval notation:

c. Interval notation:



Interval notation: с.

b.



12. **x** + 4 > 12





Adult Learning Academy Elementary Algebra Workbook 1.13 COLOR MATCHING INEQUALITIES



Find three ways (one from each column) to express the same inequality. Color the matches the same color.

	x > 3	(-∞, 3)
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	x < -3	[3, ∞)
	x <u>></u> 3	(-∞, 3]
	-3 < x <u><</u> 3	$(3,\infty)$
	x <u><</u> -3	(-3, 3)
	-3 < x < 3	[-3, 3)
	x <u><</u> 3	(-3, 3]
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	-3 <u><</u> x < 3	(-∞, -3)
	x <u>></u> -3	[-3, ∞)
-5 -42 -1 0 1 2 3 4 5	x < 3	(-∞,-3]



Adult Learning Academy Elementary Algebra Workbook 1.12 CAREER APPLICATIONS: STEM



- 1. A laptop computer weighs 3 pounds.
 - a. How much would 2 computers weigh?
 - b. How much would 10 computers weigh? _____
 - c. How much would x computers weigh? _____
- 2. An experimental plant has X leaves. Write an expression for the number of leaves on these plants:
 - a. A plant with two more leaves than the experimental plant:
 - b. A plant with 4 fewer leaves than the experimental plant:
 - c. A plant with twice as many leaves as the experimental plant:
 - d. A plant with 3 more than 5 times as many leaves as the experimental plant:
 - e. A plant with 1 less than twice as many leaves as the experimental plant: _____
 - f. A plant with the same number of leaves as the experimental plant:
- 3. One solution contains X milliliters of saline. A second solution contains Y milliliters of saline. Write an expression for each situation:
 - a. If we add 20 ml of saline to the first solution, how much saline will it contain?
 - b. The total saline used in both solutions:
 - c. If X > Y, how much more saline is in the first solution than the second?
 - d. The mean amount of saline in the two solutions:
 - e. If we double the amount of saline in each solution, what will be the total amount of saline?
 - f. If we pour the first solution equally into four smaller beakers, how much saline will be in each?

- 4. Using the variable R to represent the number of millions of red blood cells (RBC) per cubic milliliter of blood. Write an EQUATION for each description (use an = sign!). Then solve.
 - a. If Charles' red blood cell count increased by 1.3, his red blood cell count would be at the maximum normal of 6. What is his current RBC?
 - b. A change in medication lowered Rhonda's RBC by 2.1, so it is now 3.9. What was Rhonda's starting RBC?
 - c. James' RBC started a medical trial at 7.2 and ended at 4.9. How much did his RBC drop during the course of the study?
 - d. If my RBC doubled, it would be 7. What is it currently?
 - e. Half of Robert's RBC would be 2.6. What is his current RBC?
 - f. The total RBC for two brothers is 12. The older brother's RBC is 1.5 higher than the younger brother's RBC. What is the red blood cell count for each brother?
 - g. The total RBC for two sisters is 9. The sick sister's RBC is double that of the healthy sister. What is the red blood cell count for each sister?
 - h. The total RBC for two siblings is 12. The brother's RBC is one less than the twice that of his sister. What is the red blood cell count for each sibling?

- 5. Write an equation for each situation. Then solve.
 - a. An updated program requires 40 gigabytes of memory more than its predecessor. The original program required 100 gigabytes. How much does its updated version require?
 - b. The perimeter of the rectangular lab is 88 feet. The length is 4 feet more than the width. What are the dimensions of the lab?
 - c. The perimeter of the rectangular computer storage room is 150 feet. The length is twice the width. What are the dimensions of the storage room?
 - d. Insurance will pay half the replacement cost due to flooded equipment, after the lab pays the \$500 deductible. The replacement costs \$15,000. How much will insurance pay?

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

a. X inches X inches	b. X feet X + 3 feet	c. X miles 2X miles
Perimeter:	Perimeter:	Perimeter:
Area:	Area:	Area:

- 7. Expressing Inequalities: Let X equal the volume of liquid to be used in an experiment. Write an inequality to describe each situation.
 - a. To avoid overloading the equipment, the volume must be at most 10 liters.
 - b. To ensure accurate measurement, the volume must be at least 3 liters.
 - c. To conduct the experiment, the volume of liquid must be between 3 and 10 liters, inclusive.
 - d. If a liter of liquid is lost to condensation, the remaining volume must be at least 3 liters.



Adult Learning Academy Elementary Algebra Workbook MODULE 1 ANSWER KEY



1.1 Do You Remember Fractions?
1. $\frac{2}{4}, \frac{3}{6}, \frac{4}{8}, \frac{50}{100}, etc$
2. $\frac{1}{1}, \frac{2}{2}, \frac{37}{37}, \frac{456}{456}, etc$
3. $\frac{9}{8}, \frac{10}{8}, \frac{5}{2}, numerator > denominator$
$4. \ \frac{1}{6}, \frac{1}{10}, \frac{1}{50}, etc$
5. $\frac{0}{2}, \frac{0}{6}, \frac{0}{329}, etc$
6. of means multiply: $\frac{1}{2} \times \frac{2}{3} = \frac{1}{3}$
7. $\frac{1}{0}, \frac{7}{0}, \frac{387}{0}, etc$
8. $\frac{7}{10}$
9. $\frac{9}{30} + \frac{4}{30} = \frac{13}{30}$
10. $\frac{60}{45} = \frac{4}{3} = 1 \frac{1}{3}$
11. $\frac{4}{5} \times \frac{15}{8} = \frac{60}{40} = \frac{3}{2} = 1\frac{1}{2}$
12. $\frac{34}{9} - \frac{7}{6} = \frac{68}{18} - \frac{21}{18} = \frac{47}{18} = 2 \frac{11}{18}$
13. $\frac{11}{2} \cdot \frac{14}{5} = \frac{154}{10} = $ 15 $\frac{2}{5}$
$14. \ \frac{3}{4} \cdot \frac{3}{4} = \frac{9}{16}$
15. $5 + \frac{9}{16} \left(\frac{4}{3}\right)^2 = 5 + \frac{9}{16} \left(\frac{16}{9}\right) = 5 + 1 = 6$

1.3 Do you Remember Integers?

1	-8	
2	-2	
3	-2	
4	-8	
5.	2	
6	-2	
7	8	
8. 1	.0	
9	-10	
10.	-5	
11.	5	
12.	-3	
13.	-25	
14.	25	
15.	$7 - 6(-1)^3 = 7 - 6(-1) =$	= 7 + 6 = 13
16.	$14 \div 7(-1)^2 = 14 \div$	-7(1) = 2
17.	$\frac{1}{2}$	
	4	

1.5 Practice with Fractions & Integers

$\frac{\frac{4}{5} + \frac{3}{10}}{= 1\frac{1}{10}}$	-1 - 1 = -2	$\frac{3}{6} - \frac{4}{8} = 0$	6 ÷ 0 undefined	$= \frac{\frac{2}{1}}{2}$
(-5)(4) = - 20	$\frac{3}{6} + \frac{5}{10} = 1$	Half of ½ = 1/4	-3 ² = - 9	Double 10. = 20
-32 + 32 = 0	$(-10)^2$ = 100	47 0 undefined	$ \frac{33}{30} 1\frac{1}{10} $	$Half of \frac{5}{3} = \frac{5}{6}$
10 – (-2) = 12	$\frac{-10}{2}$ = -5	$\frac{-50}{-25} = 2$	-15 – 5 = -20	7 + (-6) = 1
-2 - 7 = - 9	$\frac{7}{14} \div 2$ $= 1/4$	$\frac{\frac{1}{2} + \frac{1}{3}}{= \frac{5}{6}}$	$\frac{0}{47} = 0$	$\frac{45}{54} = \frac{5}{6}$
15 – (-5) = 20	$5\frac{1}{2} \div 5$ $1\frac{1}{10}$	$3\frac{1}{2} \cdot 1\frac{1}{2}$ $= 5\frac{1}{4}$	-4 - 1 = -5	-5 + 3 = - 2
$\frac{15}{37}\cdot\frac{37}{15}$	-6 ÷ 3 = - 2	10^2 = 100	-11 + 2 = - 9	3 – 5 = 2
$5\frac{1}{4}$	9 ÷ (3 – 3) undefined	(- <u>3)(</u> -4) = 12	$\frac{\frac{3}{2} \div \frac{2}{7}}{= 5\frac{1}{4}}$	0 – 5 = - 5
$\frac{5}{2} \cdot \frac{24}{5} = 12$	(- <u>4)(</u> -5) = 20	$50 \div \frac{1}{2}$ = 100	$-12 \cdot \frac{5}{3} = -20$.25 = 1/4

1.6 Simplifying Expressions

1. 8x
2. 2x
32x
4. 2x
5. 0
6. x ²
7. 1
8. x + y (not like terms)
9. $8x + 2y$
10. $5x - 10$
11. $5x - 5 + 3x + 6 = 8x + 1$
12. $3x + 5 - 2x - 1 = x + 4$
13. $3x + 5 - 2x + 1 = x + 6$
14. $3x + 10x - 5 = 13x - 5$
15. $3x - 10x + 5 = -7x + 5$
16. $7 - 6x + 3 = 10 - 6x$
17. $7 - 6x - 3 = 4 - 6x$

1.7 One-Step Equations 1. x + 3 - 3 = 15 - 3x = 12**2.** x - 4 + 4 = 20 + 4x = 24**3.** 6y/6 = 48/6 y = 8 4. $(\frac{a}{3})$ 3 = (12)3 a = 36 **5.** w + 100 - 100 = -300 - 100w = -400 6. x - 12 + 12 = -20 + 12x = -8**7.** -6y/-6 = 48/-6 **y** = -8 **8.** $(\frac{a}{3})$ **3** = (-9)**3** a = -27 9. -5 - 4 = x + 4 - 4-9 = x or x = -910. 5x/5 = 7/5x = 7/511. $(\frac{1}{2} x)^2/1 = (12)^2/1$ **x** = 24 12. $(\frac{3}{4} x)4/3 = (18)4/3$ **x** = 72/3 = **24 13.** 7x/7 = 7/7 **x = 1 14.** $x - \frac{1}{2} + \frac{1}{2} = \frac{3}{2} + \frac{1}{2}$ $x = \frac{4}{2} = 2$ **15.** -x/-1 = -7/-1 **x** = **7 16.** 5x/5 = 0/5 **x** = **0**

1.8 Two-Step Equations

1. 2x + 1 - 1 = 7 - 1 2x = 6 2x/2 = 6/2 x = 32. 3x - 1 + 1 = 11 + 1 3x = 12 3x/3 = 12/3 x = 43. -2x + 1 - 1 = 9 - 1 -2x = 8 -2x/-2 = 8/-2x = -4

<u>1.8 Two-Step Equations (cont.)</u> 4. -5x - 1 + 1 = 9 + 1-5x = 10-5x/-5 = 10/-5 $\mathbf{x} = -2$ **5.** 5 + 3x - 5 = 17 - 53x = 123x/3 = 12/3**x** = **4** 6. 7 - 3x - 7 = 13 - 7-3x = 6-3x/-3 = 6/-3**x** = -2 7. 7 - 5 = 5 + 2x - 52 = 2x2/2 = 2x/21 = x or x = 18. 10 - 3x - 10 = 13 - 10-3x = 3-3x/-3 = 3/-3x = -1 9. $(\frac{x+4}{3})$ 3 = (10)3 x + 4 - 4 = 30 - 4x = 2610. $(\frac{x-7}{5})$ 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. $\frac{w}{3} - 10 + 10 = 0 + 10$ $\left(\frac{w}{2}\right)\mathbf{3} = (10)\mathbf{3}$ w = 30

<u>1.9 Multi-Step Equations</u>

1.
$$x + 3x = 12$$

 $4x = 12$
 $4x/4 = 12/4$
 $x = 3$
2. $5x - 3x + 2 = 12$
 $2x + 2 = 12$
 $2x + 2 - 2 = 12 - 2$
 $2x = 10$
 $2x/2 = 10/2$
 $x = 5$

1.9 Multi-Step Equations 3. 3x - 5x + 2 = 12-2x + 2 = 12-2x + 2 - 2 = 12 - 2-2x = 10-2x/-2 = 10/-2x = -5 4. 5(x-2) = 205x - 10 = 205x - 10 + 10 = 20 + 105x = 305x/5 = 30/5**x** = 6 5. 3(x + 1) = 153x + 3 = 153x + 3 - 3 = 15 - 33x = 123x/3 = 12/3 $\mathbf{x} = \mathbf{4}$ **6.** -2(x + 4) = 16-2x - 8 = 16-2x - 8 + 8 = 16 + 8-2x = 24-2x/-2 = 24/-2x = -12 7. 3x - x = x + 4 - x2x = 42x/2 = 4/2 $\mathbf{x} = \mathbf{2}$ 8. 4x - 2x = 2x + 10 - 2x2x = 102x/2 = 10/2 $\mathbf{x} = \mathbf{5}$ 9. -5x + 3 + 5x = -4x + 5x3 = 1x or x = 3**10.** x - 5 - x = 2x - x-5 = x or x = -5**11.** 2(x + 1) = x - 32x + 2 = x - 32x + 2 - 2 = x - 3 - 22x = x - 5 $2\mathbf{x} - \mathbf{x} = \mathbf{x} - \mathbf{5} - \mathbf{x}$ 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 + 2x5 = 5x5/5 = 5x/51 = x or x = 1

1.10 Expressions and Equations 1. 3x 2. 3x - 12 3. 4x 4. 2 - x (not like terms) 5. x - 8 6. 7 - 2x - 2= 5 - 2x7.7 - 2x + 2= 9 - 2x8. 3¹/₂x or 3.5x 9. 3x = 12x = 12/3 = 410. 3x - 12 = 53x = 17x = 17/3 = 5 2/3 or 5.666 11. 4x = -20x = -20/4 = -512. -x = -8-x/-1 = -8/-1 so x = 8**13.** x - 8 = 80 so x = 8814. 7 - 2x - 2 = -15 - 2x = -1-2x = -6**x** = -6/-2 = **3** 15. 7 - 2x + 2 = -19 - 2x = -1-2x = -10x = -10/-2 = 516. 3.5x = 7x = 7/3.5 = 2**1.11 Special Equations** 1. x = 0 conditional 2. identity 3. contradiction 4. identity 5. contradiction **6.** $\mathbf{x} = -1$ conditional 7. identity 8. contradiction 9. x = -1 conditional 10. identity 11. x = 0 conditional 12. x = 3 conditional 13. x = 1 conditional 14. contradiction

 $15. \quad x = 5 \text{ conditional}$

1.12 Solving Inequalities



<u>1.12 Solving Inequalities (cont.)</u>



<u>1.13 Color Matching Inequalities</u>

* <u>+ + + + + + + + + </u>	x > 3	(-∞, 3)
	x < -3	[3, ∞)
	x <u>></u> 3	(-∞, 3]
	-3 < x <u><</u> 3	(3, ∞)
<	x <u><</u> -3	(-3, 3)
	-3 < x < 3	[-3, 3)
	x <u><</u> 3	(-3, 3]
	-3 <u><</u> x < 3	(-∞, -3)
	x <u>></u> -3	[-3, ∞)
	x < 3	(-∞,-3]

1.14 Career Pathway Applications – STEM (cont.) 1a. $3 \cdot 2 = 6$ pounds **1b.** 3 • 10 = **30 pounds** 1c. $3 \cdot x = 3x$ pounds 2a. x + 22b. x - 42c. 2x 2d. 5x + 32e. 2x - 12f. 2x - 13a. x + 20 or 20 + x3b. x + y3c. x - y3d. $\frac{1}{2}(x+y)$ or $\frac{x+y}{2}$ 3e. 2x + 2y or 2(x + y)3f. x/4 or ¹/₄ x or .25x 4a. $\mathbf{R} + \mathbf{1.3} = \mathbf{6}$ R + 1.3 - 1.3 = 6 - 1.3 **R** = 4.7 4b. R - 2.1 = 3.9R - 2.1 + 2.1 = 3.9 + 2.1 $\mathbf{R} = \mathbf{5}$ 4c. 7.2 - R = 4.97.2 - R - 4.9 + R = 4.9 - 4.9 + RR = 2.34d. 2R = 72R/2 = 7/2 $R = 3\frac{1}{2} \text{ or } 3.5$ 4e. .5R = 2.6.5R/.5 = 2.6/.5R = 5.24f. *let* R = the younger brother's RBC = 5.25 So R + 1.5 = older brother's RBC = 6.75 R + R + 1.5 = 122R + 1.5 - 1.5 = 12 - 1.52R/2 = 10.5/2R = 5.24g. let R = the healthy sister's RBC = 3 So 2R = the sick sister's RBC = 6 R + 2R = 93R/3 = 9/3 $\mathbf{R} = \mathbf{3}$

1.14 Career Pathway Applications – STEM (cont.) 4h. *let* R =the sister's RBC = **4** 1/3 or **4.333** So 2R - 1 = the brother's RBC = 7 2/3 or 7.667 R + 2R - 1 = 123R - 1 + 1 = 12 + 13R/3 = 13/3 **R = 4 1/3 or 4.333** R = 5.252R/2 = 10.5/2**5a.** *let* x = the updated program = 5.25 x = 100 + 40 = 140 gigabytes **5b.** *Perimeter* = *sum of all sides (rectangle has 4* sides) *let* width = W and let length = W + 4 $\mathbf{W} + \mathbf{W} + \mathbf{W} + \mathbf{4} + \mathbf{W} + \mathbf{4} = \mathbf{88}$ 4W + 8 - 8 = 88 - 84W/4 = 80/4 W = 20 width = 20ft. length = 24ft. **5b.** *let* width = W and let length = 2WW + W + 2W + 2W = 1506W/6 = 150/6 W = 25 width = 25ft. length = 50ft. **5b.** *let* x = the amount insurance will pay x = 1/2(15,000 - 500) $\mathbf{x} = 1/2(14,500) =$ **\$7,250** *Perimeter* = sum of all sides; Area = Length x Width 6a. P = 4x inches $A = x^2$ inches **6b.** P = 4x + 6 feet $A = x^2 + 3$ sq. feet 6c. P = 6x miles $A = 2x^2$ miles 7a. x < 10 7b. x > 37c. 3 < x < 10

7d. $3 \le x - 1 \le 10$ or $4 \le x \le 11$



Adult Learning Academy Elementary Algebra Workbook



MODULE 2: APPLICATIONS OF LINEAR EQUATIONS IN ONE VARIABLE, FUNCTION NOTATION

Learning Objectives

By the time you finish this module, you should be able to:

- □ Translate verbal expressions to the symbolic language of algebra
- \Box Use a variety of problem-solving strategies.
- \Box Solve word problems about unknown numbers that are related to each other.
- \Box Use a given formula to solve problems.
- \Box Solve a given formula to isolate a specified variable.
- \Box Solve distance problems using the formula D = RT
- \Box Solve problems involving simple interest using the formula I = PRT
- □ Solve problems involving ratios and proportions.
- \Box Solve percent problems.
- \Box Solve mixture problems.
- \Box Find the perimeter of a rectangle.
- \Box Use function f(x) notation to plug a value in for x.

IMPORTANT INFORMATION FROM MODULE 2:

Consecutive integers: x, x + 1, x + 2, x + 3, etc. Consecutive odd or consecutive even integers: x, x + 2, x + 4, etc. To DOUBLE a number means to multiply it by 2 (you might write 2x) Translations: "of" means "multiply"; "is" means "equal" To solve a proportion, cross multiply.

D = rt (distance = rate x time) I = PRT (interest = principal x rate x time) Perimeter of a rectangle = 2L + 2W

Strategies: Draw a diagram! Look for key words. Read the problem several times. Write a variable for the unknown quantity you wish to find. Try some simple numbers to get a feel for what's happening. Make a guess and adjust. Make a table. See what happens one year at a time, one hour at a time, etc. Notice patterns.

f(x) is pronounced "f of x". It means to plug the given number in for x. For example, f(3) means to plug the number 3 in wherever you see an x in the function, and calculate the answer.



Adult Learning Academy Elementary Algebra Workbook MODULE 2 VIDEO & EXERCISE LIST



Торіс	Website	Videos	Exercises	
Expressions	www.khanacademy.org	Evaluate an Expression	Evaluating expressions in 1 var.	
and Formulas		Evaluate a Formula using Substitution		
		Age Word Problems 1		
Various Word	www.khanacademy.org	Basic Linear Equation Word Problems	Linear Equation Word Problems	
Problem Examples	http://www.youtube.com/watch?v=JNusKkf3wbI&list	<u>=PLBUJyzEUI_hyrLI_kbMbWmyKNuZOJ</u>	<u>5Nf_</u>	
	http://www.youtube.com/watch?v=Qv0vF0rH1aM&lis	st=PLBUJyzEUI_hyrLI_kbMbWmyKNuZC	<u>DJ5Nf_</u>	
	http://www.youtube.com/watch?v=bJC4dqEW1gQ&list=PLBUJyzEUI_hyrLI_kbMbWmyKNuZOJ5Nf_			
	http://www.youtube.com/watch?v=FG3bwWhkHTU&	<u>list=PLBUJyzEUI hyrLI kbMbWmyKNu2</u>	ZOJ5Nf_	
Simple Interest	http://www.youtube.com/watch?v=r3-lyBGlJ98	The Simple Interest Formula		
Ratio and Proportion	www.khanacademy.org	Introduction to Ratios	Expressing Ratios as Fractions	
		Ratios as Fractions in Simplest Form	Ratio Word Problems	
		Simplifying Rates and Ratios	Writing Proportions	
		Writing Proportions	Proportions1	
		Understanding Proportions		
Percent Problems	www.khanacademy.org	Representing # as Dec, %, Fraction	Converting Percents to Dec	
		Growing by a Percentage	Discount Tax and Tip	
		Solving Percent Problems	Markup, Commission	
		Solving Percent Problems 2		
Use Proportions	http://www.youtube.com/watch?v=yl0Rb6T09VM			
Use Equations	http://www.youtube.com/watch?v=LkTYkHbUiU4			
Mixture Problems	www.stlcc.edu	Powerpoint: Mixture Problems		
	http://www.youtube.com/watch?v=gD2YfPU-qMM			
	http://www.youtube.com/watch?v=DwEsBCHM_jc			
Functions	http://www.youtube.com/watch?v=VUTXsPFx-qQ			
Function Notation	http://www.youtube.com/watch?v=S1uAy5vM4HI			
	www.khanacademy.org	Understanding Function Notation Ex 1		

Торіс	Website	Videos	Exercises
Module 2 Test Review	http://www.youtube.com/watch?v=WQYzOpcnWxs	Helpful System to Solve Word Problems	
	stlcc.edu		Mixture Problem PowerPoint
			Module 2 Review Flashcards



Adult Learning Academy Elementary Algebra Workbook 2.1 PROBLEM SOLVING STRATEGIES



Before you start to panic at the thought of an entire module dedicated to the dreaded word problem, consider this:



The whole point of studying math is to be able to USE it to solve real-life problems.

Real-life situations are expressed in WORDS.

So the goal of math is to be able to solve word problems!

This module will allow you to practice solving the equations from module 1, but in the context of reallife situations. We use the symbols of math to model what's going on in the problem.



There are many tools you can use to help you approach word problems. Not every tool helps with every problem. There are many ways to approach every problem. The more tools you have, the easier the job becomes. Here are some tips:

* **Draw a picture!** You don't have to be an artist. Diagrams are especially useful for problems involving distance, mixtures, area, and perimeter. If you can picture it, you can solve it!



* **Try some simple numbers!** You can often get a feel for a problem by using your own "easy" numbers just to see how they are related. For example, say that a problem asks how many hours it will take to travel 37.5 miles at 22 miles per hour. If you don't know where to start, consider how long it would take to drive 100 miles at 50 miles per hour—that would take 2 hours (the first 50 miles would take one hour, the next 50 miles would take another hour). How can you use 100 and 50 to get 2? Divide! Then go back to the original problem and divide 37.5 by 22.



* **Take a guess!** Some people feel like they are "cheating" if they try to guess the answer, but it can be a great way to start. For example, say you are trying to find two numbers that add up to 99, and one number is twice as big as the other. You might guess that the numbers are 30 and 60, since 60 is twice as big as 30. Those don't add up to 99, but they are close. They are just a little too small. Don't give up because your guess wasn't perfect—adjust your guess! 31 + 62 would be better, but still a bit too small. 32 + 64 would be even closer, but still too small. How about 33 + 66? You've got it!
* **Replace words with algebra!** For example, in the problem above, you were looking for two numbers whose sum is 99, and one number is twice the other. You might write the following:





In Algebra, X stands for a number we don't know yet. Replace the number in the first box with X. The "other number" is twice as big as X, so call it 2X. This gives us X + 2X = 99. You can solve the equation and find out that X = 33.

X + 2X = 99. You can solve the equation and find out that X = 33.



* **Remember a similar problem!** Try to notice the overall structure of the problems you solve, so you can apply what you've learned to new problems. A problem about a boat instead of a car, or a lady named Gertie instead of a guy named George, or two animals approaching each other instead of leaving each other, or a shopkeeper mixing coffee beans instead of a pharmacist mixing medicines, could be the same basic problem, solved the same way!



* **Go one step at a time!** In a distance problem, what's happening after one hour? After two hours? Three? In an interest problem, how much interest do you have after one year? Two years? Three? If you work step by step, you'll start to see a pattern!



* **Check your answer!** Did you just say that a lady is 325 years old? Or you need 3.27 buses, or a rectangle is -5 feet long? Did a number that was supposed to be larger get smaller? Then chances are you did not solve the problem correctly! Use the common sense that is built into your wonderful brain! Always label your answer and read the question one last time to be sure you answered the question asked, and that your answer is reasonable.

Resources (from top to bottom):

panic is available in the Public Domain under the <u>CC0 license</u>. <u>toolbox</u> is available in the Public Domain under the <u>CC0 license</u>. <u>painter</u> is available in the Public Domain under the <u>CC0 license</u>. <u>question mark</u> is available in the Public Domain under the <u>CC0 license</u>. <u>baby-twins-wrapped</u> is available in the Public Domain under the <u>CC0 license</u>. <u>sport-train-active</u> is available in the Public Domain under the <u>CC0 license</u>. <u>download-successful-tick</u> is available in the Public Domain under the <u>CC0 license</u>.





A formula is just an EQUATION with more than one VARIABLE. Formulas express how different amounts are related. As an example, we'll use the distance formula:

D = **rt** This formula tells you that the distance you travel is equal to your rate

(speed), multiplied by the time you travel. You use this formula without even thinking about it. For example, if you have been driving for 2 hours at 60 miles per hour, you know that you have driven 120 miles.

The formula has three variables: **D** to represent Distance, **r** to represent rate (speed), and **t** to represent time. Any word problem involving this formula will give you values to plug in for TWO of the three variables, and will leave one for you to figure out.

Examples: A car travels at 50 miles per hour for 3 hours. How far does it travel? Here, you know the rate and the time, and must find the distance: $D = 50 \cdot 3 = 150$ miles.

> How long will it take to drive 100 miles at a rate of 20 miles per hour? Here, you know the distance and the rate, and must find the time: $100 = 20 \cdot t$, so t = 5 hours.

I rode my bike for 2 hours and went 20 miles. How fast was I riding? Here, you know the distance and the time, and must find the rate: $20 = r \cdot 2$, so r = 10 miles per hour.

If a formula has 100 variables (don't worry, there are none of those here!), the problem will have to give you values to plug in for 99 of those variables. You'll always have just ONE missing number to find.

Solving a Formula for a particular variable: some problems don't give you any numbers. They just ask you to "solve for" x, or "solve for" some other variable. DO NOT JUST INVENT SOME NUMBERS! The problem is asking you to write the formula with the specified variable all alone on one side of the equation.

Examples: Solve for r: D = rtWe want the r to be alone. The way the formula is written, the r is multiplied by t. To undo that multiplication, divide both sides of the equation by t. This makes our formula $\frac{D}{t} = r$. The r is isolated. Mission accomplished. Solve this formula for y: 3x + y = 7We want the y to be alone. The way the formula is written, the y has 3x added to it. To undo that addition, subtract 3x from both sides of the equation. This makes our formula y = 7 - 3x. The y is isolated. Mission accomplished.



INPUT x

FUNCTION f: X + 1

OUTPUT f(x)

Adult Learning Academy Elementary Algebra Workbook 2.3 FUNCTION NOTATIONS



You can think of a function as a machine. Every function machine takes whatever number you give it as input, works with that number, and gives you back a number as output. Consider this function, whose job is to always add 1:

If we stick a 5 into the function machine, it adds 1 and spits out a 6. We write f(5) = 6 and we say "f of 5 equals 6".

If we stick a 99 into the function machine, it adds 1 and spits out a 100. We write f(99) = 100 and we say "f of 99 equals 100".

If we stick a 3.7 into the function machine, it adds 1 and spits out a 4.7. We write f(3.7) = 4.7, and we say "f of 3.7 equals 4.7".

In other words, we can input any value of x we choose, and a new number will come out, always according to the same rule.

Here is another function machine. This one takes whatever number we input, multiplies it by 2, and subtracts 3:



OUIPUI f(

1. PRACTICE:

- a. What is f(20)?
- b. What is f(0)?
- c. What is f(-50)?

If we input a 5, the machine will take that 5, multiply it by 2, and subtract 3: $f(5) = 2 \cdot 5 - 3 = 10 - 3 = 7$. We write f(5) = 7, and we say that "f of 5 equals 7".

If we input a 100, the machine will take that 100, multiply it by 2, and subtract 3: $f(100) = 2 \cdot 100 - 3 = 200 - 3 = 197.$

We write f(100) = 197, and we say that "f of 100 equals 197".

Of course, we don't always have to draw the function machine. And not every machine has to be called "f". Let's say we have these functions:

$$f(x) = x + 7$$
 $g(x) = 2x + 5$ $h(x) = x^2$

Let's pick some values for x. Let's see what each function does when x is 3:

$$f(3) = 3 + 7$$
 $g(3) = 2 \cdot 3 + 5$ $h(3) = 3^2$ $f(3) = 10$ $g(3) = 11$ $h(3) = 9$

Now we'll see what each function does if the x is 0:

$$f(0) = 0 + 7$$
 $g(0) = 2 \cdot 0 + 5$ $h(0) = 0^2$ $f(0) = 7$ $g(0) = 5$ $h(0) = 0$

2. <u>**PRACTICE**</u>: Use the same functions above to calculate the following:

c. f(8) f. g(8) i. h(8)



Adult Learning Academy Elementary Algebra Workbook 2.4 CAREER APPLICATIONS: STEM



I. WRITING ALGEBRAIC EXPRESSIONS =

Use the given information to change the initial number of bees in the colony as described:

1.	Environmental researchers have been observing a colony of 50,000 bees	2.	Researchers cannot tell how many bees are in the colony initially. Use the variable X to represent the number.
a.	If 10,000 bees joined the colony, how many would there be?	a.	If 10,000 bees joined the colony, how many would there be?
b.	If 5,000 of the original bees died, how many would be in the colony?	b.	If 5,000 of the original bees died, how many would be in the colony?
c.	Double the original number of bees:	c.	Double the original number of bees:
d.	Cut the original number of bees in half:	d.	Cut the original number of bees in half:
e.	Triple the original number of bees:	e.	Triple the original number of bees:
f.	Decrease the number of bees by 100:	f.	Decrease the number of bees by 100:
g.	How many is 200 less than half the original number of bees?	g.	How many is 200 less than half the original number of bees?
h.	How many is 50 more than twice the original number of bees?	h.	How many is 50 more than twice the original number of bees?
i.	What is the total number of bees in a dozen colonies this size?	i.	What is the total number of bees in a dozen colonies this size?
j.	The colony produces 5 liters of honey. How much honey is this per bee?	j.	The colony produces 5 liters of honey. How much honey is this per bee?

II. FIND THE SECRET NUMBERS!

Be sure to set up an equation, identify your variable, label your answer, and check that you answered the question and your answer makes sense!

- 3. There are 75 patients on a maternity ward. The number of mothers is twelve less than twice the number of babies. How many mamas and how many babies are on the ward?
- 4. A pair of twins weigh a total of 63 pounds. Their weights are consecutive integers. How much does each twin weigh?
- 5. A pair of twins weigh a total of 158 pounds. Their weights are consecutive even integers. How much does each twin weigh?
- 6. A set of triplets weigh a total of 117 pounds. Their weights are consecutive odd integers. How much does each triplet weigh?
- 7. The perimeter of a laboratory is 44 feet. The length and width are consecutive even integers. What are the dimensions of the room? (Remember, to find perimeter, add up the lengths of all four sides!)
- 8. There are 132 researchers at a workshop. Some are biologists, while the rest are chemists. The number biologists is twelve less than twice the number of chemists. How many biologists and how many chemists are at the workshop?
- 9. Two studies would have taken exactly the same amount of time, but because of an equipment malfunction, one had to extend its observations for 5 days. Altogether, the two studies lasted 195 days. How long was each study?

- 10. According to GPS, three routes to the same destination have distances that are consecutive odd integers. Driving all three routes would make a total of 117 miles. How far is the most direct route?
- 11. Three plants have a total height of 83 centimeters. The first is 3 centimeters shorter than the second. The third is 5 centimeters taller than the second. How tall is each plant?
- 12. According to the Tornado History Project (www.tornadohistoryproject.com), the total number of tornadoes in Missouri in 2012, 2013, and 2014 was 125. The number in 2012 was 20 less than the number in 2013. The number in 2014 was two less than the number in 2013. How many tornadoes hit Missouri each year?
- 13. Andre spent a total of \$1880 to buy a new i-Pad mini and a new MacBook Pro. The MacBook cost \$290 more than twice times the cost of the i-Pad. How much did each cost?

III. WORKING WITH FORMULAS =

14. KINETIC ENERGY FORMULA

Kinetic Energy, or KE, is energy of motion. If the mass and velocity of a body are known, the kinetic energy can be determined by this formula:

 $\frac{\mathbf{KE} = \mathbf{mV}^2}{2}$ where $\mathbf{KE} = \mathbf{Kinetic}$ Energy in Joules m = mass in kilograms V = velocity in meters/sec

- a. Calculate the kinetic energy of a brown bear with a mass of 317 kg that runs at 15.5 meters/sec.
- b. The Kinetic Energy of a 650-kg roller coaster car is 105,300 Joules. How fast is the car rolling?

- c. The kinetic energy of a boat is 52,000 Joules. The boat is moving at 1.63 meters/sec. What is the boat's mass?
- d. The Lockheed SR-71 Blackbird, a high-altitude spy plane, has a mass of 77,000 kg, and at top speed it has a kinetic energy of 37,000,000,000 J. What is the top speed of the SR-71?
- e. How fast is a 65-kilogram skydiver falling if her kinetic energy is 704,000 Joules?
- f. Solve the formula above for mass (that is, get the variable m by itself on one side of the equation).

15. TEMPERATURE CONVERSION FORMULAS

In the United States, most people use a Fahrenheit temperature scale. Along with the rest of the world, however, the Federal Aviation Administration (FAA) uses the Metric temperature scale for weather reports, to temperature is measured in degrees Celsius. You can use these two formulas to convert between the two:

degrees
$$F = \frac{9}{5}C + 32$$
 degrees $C = \frac{5}{9}(F - 32)$

- a. Water freezes at 32° Fahrenheit. What is this in Celsius?
- b. Water boils at 212° Fahrenheit. What is this in Celsius?

- c. Normal human body temperature is 98.6° Fahrenheit. What is this in Celsius?
- d. In sub-freezing temperatures, the wings of a plane must be deiced. The deicing chemical glycol works like antifreeze in a car, reducing the freezing point of water to as low as -50 degrees Celsius. What is this temperature in Fahrenheit?
- e. The hottest day ever in Missouri reached 47.8 degrees Celsius. What is this in Fahrenheit?
- f. The coldest day ever in Missouri reached -40 degrees Fahrenheit. What is this in Celsius? WHAT DO YOU NOTICE???

16. DISTANCE FORMULA

Use the distance formula $(\mathbf{d} = \mathbf{rt})$ to solve the problems below.

The Shinkansen Bullet Train in Japan travels at a rate of up to 200 miles per hour.

- a. At this rate, how long would it take to travel 800 miles?
- b. At this rate, how long would it take to travel 1100 miles?
- c. At this rate, how far could you travel in 8 hours?

- d. If we had a similar train, how long would it take to travel the 300 miles from St. Louis to Chicago?
- e. In a car traveling 60 miles per hour, how long does it take to travel the 300 miles from St. Louis to Chicago?
- f. A car leaves St. Louis and heads for Chicago at 55 miles per hour. Another car leaves Chicago and heads for St. Louis at 45 miles per hour. How long will it take them to meet? (Remember, it's about 300 miles between the two cities.)
- g. Two trains leave the same station at noon, but one goes north and the other goes south. One train is traveling twice as fast as the other. By 5:00 pm, the trains are 450 miles apart. How fast are the trains going?
- h. Solve the formula D= rt for time (that is, get *t* by itself on one side of the equation).
- 17. SIMPLE INTEREST FORMULA

Solve each problem, using the formula:

I = PRT, where I = the amount of interest in dollars P = the principal in dollars R = the interest rate written as a decimal T = time in years

- a. Solve the formula above for P (that means get the variable P by itself on one side of the equation).
- b. If you borrow \$5000 for training expenses at 3% simple interest for 2 years, how much money will you pay in interest?

- c. You invested \$7000 at 3.5% simple interest. How long will it take you to earn \$1225 in interest?
- d. You invested some money at 3.25% simple interest for 5 years and earned \$1218.75 in interest. How much did you invest?
- e. You invested your inheritance in two funds. You put some money in an account that pays 5% simple interest, and twice as much money in account paying 7% simple interest. After 2 years you earned \$ 570. How much was your inheritance?

IV. RATIOS AND PROPORTIONS =

18. Gear ratio is the number of teeth each gear represents when two gears are used in a machine. For example, a pinion gear has 8 teeth and a spur gear has 28 teeth. The gear ratio is 8:28, which simplifies to 1:7. Simplify ratio below:

a.	40:4	e.	15:10
b.	55:11	f.	1/2: 1/3
c.	168:14	g.	1/2:5
d.	52:13	h.	1/2:3/4

19. Which car below gets the highest MPG, or miles per gallon?



Honda Civic Drove 224 miles on 7 gallons



Toyota Corolla Drove 335 miles on 15 gallons



Ford Fiesta Drove 620 miles on 20 gallons

20. 1 mole of carbon has a mass of 12 grams. What is the mass of 5.5 moles of carbon?

21. It is estimated that a 40-milliliter pond water sample contains 10,700 paramecia. How many paramecia would be found in 2000 milliliters of this water?

22. The ratio of male to female elephants in a herd is usually about 1:6. There are 300 elephants in the herd. About how many would you expect to be female?

23. 1 gram of Agarose is required to make 60 milliliters of Agarose Gel solution. How much Agarose is needed to make 865 milliliters?

24. In 1 kilogram of river sediment, there are about 156,000 insect larvae. How many larvae would be in .07 kilograms of this sediment?

25. Two tablets of ulcer medication contain 250 milligrams of medication. How many milligrams are in eight tablets?

- 26. The scale on a map is a ratio of actual distance to distance shown on the map. On a particular map, 1 inch = 50 miles.
 - a. The distance from Point A to Point B on the map is 3 inches. What is the actual distance? Could you do this in your head?
 - b. The distance from Point B to Point C on the map is .5 inches. What is the actual distance? Could you do this in your head?
 - c. The actual distance across town is 22 miles. How will this distance appear on the map?
- 27. Convert the following, knowing that **1 kilogram = 2.2 pounds**
 - a. A male orca can weigh up to 19,000 pounds = ______ kilograms
 - b. An adult tiger weighs 675 pounds = _____ kilograms
 - c. A newborn giraffe weighs 100 kilograms = _____ pounds.

V. PERCENT PROBLEMS _____

28. When viewing sea urchin embryonic cells undergoing mitosis, you record the following number of cells in each phase of the cell cycle. Fill in the percentages:

Phase of Cell Cycle	Number of Cells in that Phase	% of all cells viewed that are in that phase
Interphase	54	
Prophase	13	
Metaphase	5	
Anaphase	2	
Telophase	1	

49

- 29. According to www.textinganddriving.com, in 2011, nationally 23% of all auto collisions involved cell phones.
 - a. A total of 1.3 million collisions in the United States in 2011 involved cell phones. How many collisions were there all together?
 - b. 1 in 5 drivers say they have surfed the web while driving. What percent is this?
 - c. 10 states prohibit cell phone use while driving. What percent is this?
 - d. 78% of the states prohibit texting while driving. How many states is this?
- 30. According to a 2013 U.S. Census Bureau (www.census.gov) report, 92.1% of the 22,331 households with occupants under 35 years of age had some type of computer. How many households is this?
- 31. An 18-wheeler requires 40% more time to stop than a car. If a car traveling at 60 mph takes 6.87 seconds to stop, how long would it take the 18-wheeler to stop?
- 32. According to the Missouri Department of Conservation, the number of hellbender salamanders in Missouri has declined about 75% since the 1980's, and are on course to become extinct in the next 20 years. If a particular river had 300 hellbenders in the 1980's, how many would it have now?
- 33. The global human population has grown from 1 billion in the 1800's to over 7 billion in 2012. What is the percent increase over this period?

- 34. The population of gray wolves in a particular area increased from 1200 to 1700. What was the percent increase?
- 35. According to the Orangutan Conservancy (www.orangutan.com), the population of orangutans in Borneo and Sumatra has decreased from about 60,000 to about 40,000 in the last decade. What percent decrease is this?

- <figure>
- 36. Use the following pie graph to answer the questions below:

- a. A+ Technology, Inc. made \$42.85 billion in revenue in 2014. How much of that revenue came from smartphones?
- b. How much revenue came from MP3 players?
- c. What percent of revenue came from services and accessories, as opposed to the products themselves?

VI. MIXTURE PROBLEMS

37. How many liters of a 5%-saline solution would have to be mixed with 150 liters of a 20%-saline solution to create a mixture that is 10% saline?

38. A super-strength cleaning chemical must be watered down to be safe for the surface to be cleaned. How many ounces of water should be added to 8 ounces of a chemical that is 30% water to create a solution that is 80% water?

39. A wing deicer is 18% glycol. How much pure glycol and how much deicer must be added to create 100 liters of a 30%-glycol deicer?

40. How many pounds of a metal containing 45% nickel must be combined with 10 pounds of a metal containing 75% nickel to create a metal that is 60% nickel?

41. Sand that cost \$2.50 per kilogram is being mixed with specially treated soil worth \$7.00 per kilogram. How much of each should be used to create 100 kilograms of a mixture worth \$5.00 per kilogram?

VII. FUNCTION NOTATION =

42. St. Louis Community College charges \$101 per credit hour, plus \$12 in fees. If x = the number of credit hours a student takes, and T(x) = Total paid, the following function describes the situation:

$$T(x) = 101x + 12$$

- a. Calculate T(3), the total cost for a 3-credit course.
- b. Calculate T(15), the total cost to be a full-time student taking 15 credit hours.
- c. Debbie paid \$921 for this semester at the Community College. How many credit hours did she take?
- d. Nancy paid \$1224 for her semester. How many credit hours did she take?
- e. If you have a \$600 budget, how many credit hours can you take?
- 43. It has been observed that the number of chirps a cricket makes per minute depends on the air temperature! Here is the function relating the temperature in degrees Fahrenheit, *t*, to the number of chirps, C(t).

$$C(t) = 4t - 160$$

- a. Calculate C(60), the number of chirps per minute when the air temperature is 60° F.
- b. Calculate C(80), the number of chirps per minute when the temperature is 80° F.
- c. You hear 40 chirps per minute. What is the temperature?
- d. You hear 60 chirps per minute. What is the temperature?
- e. At what temperature do you hear NO chirping from the crickets?

RESOURCES

Images used in section VI, question 2

Honda Civic 1.6 i-DTEC Elegance (IX, Facelift) by OM 93 is licensed under CC-BY-SA-3.0 (DE)

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= **37 lbs.**

= **39 lbs.**

= 41 lbs.

2.3 Function Notations	2.4 Career Applications: STEM (cont.)
1a. $f(20) = 2(20) - 3$	2a. $x + 10,000$
= 40 - 3	2b. $x - 5,000$
= 37	2c. $2x$
1b. $f(0) = 2(0) - 3$	2d. $1/2x$
= 0 - 3	2e. $3x$
= -3	2f. $x - 100$
1c. $f(-50)$	2g. $1/2x - 200$
= 2(-50) - 3	2h. $2x + 50$
= -100 - 3	2i. $12x$
= -103	2j. $5/x$ liters
2a. $f(2) = 2 + 7$	3. <i>let</i> $x =$ the number of babies = 29
= 9	<i>So</i> $2x - 12 =$ the number of mothers = 46
2b. $f(-10) = -10 + 7$	x + 2x - 12 = 75
= -3	3x - 12 + 12 = 75 + 12
2c. $f(8) = 8 + 7$	3x/3 = 87/3 $x = 29$
= 15	4. <i>let</i> x = the lighter twin = 31 lbs.
2d. $g(2) = 2(2) + 5$	So x + 1 = the heavier twin = 32 lbs.
= 4 + 5	x + x + 1 = 63
= 9	2x + 1 - 1 = 63 - 1
2e. $g(-10) = 2(-10) + 5$	2x/2 = 62/2 $x = 31$
= -20 + 5	5. <i>let</i> $x =$ the lighter twin $= 78$ lbs.
= -15	<i>So</i> $x + 2 =$ the heavier twin $= 80$ lbs.
2f. g(8) = 2(8) + 5	x + x + 2 = 158
= 16 + 5	2x + 2 - 2 = 158 - 2
= 21	2x/2 = 156/2 $x = 7$
2g. h(2) = 2 ² = 4 2h. h(-10) = -10 ² = 100 Check this one carefully! 2i. h(8) = 8 ²	6. let $x =$ the lightest triplet = 37 lbs so $x + 2 =$ the middle triplet = 39 lbs and $x + 4 =$ the heaviest triplet = 41 lbs x + x + 2 + x + 4 = 117 3x + 6 - 6 = 117 - 6 3x/3 = 111/3 $x = 37$
= 04 <u>2.4 Career Applications: STEM</u> 1a. 60,000 1b. 45,000 1c. 100,000	7. Perimeter = sum of all 4 sides let x = the width = 10 ft. so x + 2 = the length = 12 ft. x + x + x + 2 + x + 2 4x + 4 - 4 = 44 - 4 4x/4 = 40/4 $x = 10$
1d. 25,000 1e. 150,000 1f. 40,000 1g. 24,800 1h. 100,050 1i. 600,000	8. let x = the number of chemists = so $2x - 12$ = the number of biologists = x + 2x - 12 = 132 3x - 12 + 12 = 132 + 12 3x/3 = 144/3 $x = 48$

Module 2: Applications of Linear Equations, Function Notation

1j. 5/50,000 = 1/10,000 = .0001 liter

= 48

= 84

2.4 Career Applications: STEM (cont.)

- 9. let x = the length of shorter study = 95 days so x + 5 = the length of the longer study = 100 days x + x + 5 = 1952x + 5 - 5 = 195 - 52x/2 = 190/2 x = 95
- 10. let x = the shortest route = 37 miles so x + 2 = the middle route = 39 miles and x + 4 = the longest route = 41 miles x + x + 2 + x + 4 = 1173x + 6 - 6 = 117 - 63x/3 = 111/3 x = 37
- 11. let x = the second plant = 27 cm so x - 3 = the first plant = 24 cm and x + 5 = the third plant = 32 cm x + x - 3 + x + 5 = 833x + 2 - 2 = 83 - 23x/3 = 81/3 x = 27
- 12. let x = 2013 = 49so x - 20 = 2012 = 29and x - 2 = 2014 = 47 x + x - 20 + x - 2 = 125 3x - 22 + 22 = 125 + 223x/3 = 147/3 = 49
- 13. let x = cost of iPad = \$530 so 2x + 290 = MacBook = \$1350 x + 2x + 290 = 1880 3x + 290 - 290 = 1880 - 2903x/3 = 1590/3 x = 530
- 14a. about 38,079.6 Joules
 14b. V² = 324, so V= the square root of 324 so 18 meters/sec
 14c. about 34,143.4 kilograms
- 14d. about 980.3 meters/sec
- 14e. about 147.2 meters/sec

14f. m =
$$\frac{2 KE}{V^2}$$

15a. 0° C
15b. 100° C
15c. 37° C
15d. F = 9/5(-50) + 32 = -58 degrees F
15e. F = 9/5(47.8) + 32 = 118.04 degrees F
15f. -40 degrees - they are the SAME!
16a. 4 hours
16b. 1100 = 200t, so t = 5.5 hours
16c. 1600 miles
16d. 1.5 hours
16e. 5 hours

16f. combined rate = 100mph, so about **3 hours 16g.** r = slower train = 30mph2r = faster train = 60mph450 = 3r(5) 450 = 15r r = 3016h. t = D/r17a. $P = \frac{I}{RT}$ **17b.** I = 5000(.03)2I = \$300 **17c.** 1225 = 7000(.035)t1225 = 245tt = \$300 **17d.** 1218.75 = P(.0325)(5)1218.75 = .1625Pt = \$7500 **17e.** *let* x = the amount you invested in 5% fund So 2x = the amount you invested in 7% fund 570 = .05(2)(x) + .07(2)(2x)570 = .1x + .28x = .38xx = \$1500 in 5% fund so 2x = \$3000 in 7% fund, and total \$4500 18a. 10:1 18b. 5:1 18c. 12:1 18d. 4:1 18e. 3:2 **18f.** $\frac{1}{2} \div \frac{1}{3} = \frac{1}{2} \cdot \frac{3}{1} = \frac{3}{2} = 3:2$ **18g.** $\frac{1}{2} \div \frac{5}{1} = \frac{1}{2} \cdot \frac{1}{5} = \frac{1}{10} = 1$: **10** 18h. $\frac{1}{2} \div \frac{3}{4} = \frac{1}{2} \cdot \frac{4}{3} = \frac{2}{3} = 2:3$ **19.** Honda = 224/7 = 32 mpg is highest Toyota = 335/15 = 22.3 mpg Ford = 620/20 = 31 mpg $\frac{1 \text{ mole}}{=}$ 20. 12 grams x grams x = 5.5(12) = 66 grams 40 ml 2000 ml $\frac{40 \text{ ml}}{10,700 \text{ paramecia}} = \frac{2000 \text{ ml}}{\text{x paramecia}}$ 21. 40x = 21,400,000x = **535,000** paramecia 6 female x females 2.2. 7x = 1800x = about **257 female elephants**

2.4 Career Applications: STEM (cont.)

 $\frac{1 \text{ gram}}{60 \text{ ml}} = \frac{\text{x grams}}{865 \text{ ml}}$ 23. 60x = 865x = about 14.4 grams Agarose

- $\frac{1 \text{ kg}}{1 \text{ kg}} = \frac{.07 \text{ kg}}{1 \text{ kg}}$ 24. 156,000 larvae – x larvae x = **10,920** larvae
- 25. $\frac{2 \text{ tablets}}{250 \text{ mg}} = \frac{8 \text{ tablets}}{x \text{ mg}}$ 2x = 2000, x = 1000 mg

 $\frac{1 \text{ inch}}{50 \text{ miles}} = \frac{3 \text{ inches}}{x \text{ miles}}$ 26a. x = **150 miles**

 $\frac{1 \text{ inch}}{50 \text{ miles}} = \frac{.5 \text{ inches}}{x \text{ miles}}$ 26b. x = 25 miles

 $\frac{1 \text{ inch}}{50 \text{ miles}} = \frac{x \text{ inches}}{22 \text{ miles}}$ 26c. 50x = 22, x = about .4 inches

27a.
$$\frac{1 \text{ kg}}{2.2 \text{ lbs}} = \frac{x \text{ kg}}{19,000 \text{ lbs}}$$

 $2.2x = 19000, \text{ x} = 8636.4 \text{ kilograms}$
27b. $\frac{1 \text{ kg}}{2.2 \text{ lbs}} = \frac{x \text{ kg}}{675 \text{ lbs}}$
 $2.2x = 675, \text{ x} = 306.8 \text{ kilograms}$

 $\frac{1 \text{ kg}}{2.2 \text{ lbs}} = \frac{100 \text{ kg}}{\text{x lbs}}$ 100 kg 27c. x = 220 pounds

- 28.
- % of All Cells Phase # Cells 54/75 = 72% Interphase 54 13/75 = 17.3% 13 Prophase 5 5/75 = 6.7% Metaphase 2 2/75 = 2.7% Anaphase Telophase 1/75 = 1.3% 1
- **29a.** 1.3 = 23% of the total accidents 1.3 = .23x

x = about 5.65 million accidents

29b. 1/5 = 20%

- **29c.** 10/50 = 1/5 = 20%
- **29d.** .78(50) = 39 states

30. .921(22,331) = **about 20,567**

- **31.** 6.87 + .4(6.87) = **about 9.62 seconds**
- **32.** 300 .75(300) = 75 hellbenders left
- **33.** Amount of increase = 6 billion.

6 = x(1)

x = 6, so 600% increase

34. Amount of increase = 500500 is what percent of 1200? 500 = x(1200)x = 500/1200 = .4166= about 42% increase

- **35.** Amount of decrease = 20,00020,000 is what percent of 60,000? 20000 = x(60000)x = 20000/60000 = .3333 = about 33% decrease
- 36a. 42% of 42.85 billion = .42(42.85) = almost \$18 billion
- 36b. 1% of 42.85 billion = .01(42,850,000,000) =**\$428,500,000**

36c. 8% + 4% = 12%

- **37.** *let* x = the number liters of 5% solution final solution will have 150 + x liters .05x + .2(150) = .1(150 + x).05x + 30 = 15 + .1x15 = .05xx = 15/.05
 - x = 300 liters of 5% saline solution
- **38.** *let* x = the number of ounces of water final solution will have x + 80zRemember that pure water contains 100% water, which = 1 .3(8) + 1x = .8(x + 8)2.4 + x = .8x + 6.4.2x = 4
 - x = 20 ounces of water
- **39.** *let* x = the number of liters of pure (100%) glycol We need 100 liters total, so we'll need (100-x) liters of deicer

1x + .18(100 - x) = .3(100)

x + 18 - .18x = 30

.82x = 12

x = 12/.82 = 14.63

x = about 14.5 liters of glycol

100 - x = about 85.5 liters of deicer

40. *let* x = the number of pounds of 45% nickel 10 + x = the number of pounds in the alloy being created .45x + .75(10) = .6(10 + x).45x + 7.5 = 6 + .6x1.5 = .15xx = 1.5/.15 = 10

x = 10 lbs. of 45% nickel

This makes sense, because using equal amounts of each material will create a percent nickel that is halfway between 45% and 75%

2.4 Career Applications: STEM (cont.)

41a. *let* x = the number of kilograms of sand 100 - x = the number of kilograms of soil 2.5x + 7(100 - x) = 5(100)2.5x + 700 - 7x = 500-4.5x + 700 = 500200 = 4.5xx = 200/4.5 = 44.44x = about 44 kilograms of sand 100 - x = about 56 kilograms of soil **42a.** T(3) = 101(3) + 12T(3) = 303 + 12 =**\$315 42b.** T(15) = 101(15) + 12T(15) = 1515 + 12 =**\$1527** 42c. 921 = 101(x) + 12921 - 12 = 101x101x = 909x = 9 credit hours **42d.** 1224 = 101(x) + 121224 - 12 = 101x101x = 1212x = 12 credit hours **42d.** 600 = 101(x) + 12600 - 12 = 101x101x = 588x = 5.88 so 5 credit hours

43a. C(60) = 4(60) - 160 C(60) = 240 - 160 = 80 chirps per minute 43b. C(80) = 4(80) - 160 C(80) = 320 - 160 = 160 chirps per minute 43c. 40 = 4t - 160 4t = 40 + 160 t = 50 degrees Fahrenheit 43c. 60 = 4t - 160 4t = 60 + 160 t = 55 degrees Fahrenheit 43c. 0 = 4t - 160 4t = 0 + 160t = 40 degrees Fahrenheit



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Adult Learning Academy Elementary Algebra Workbook



MODULE 3: THE RECTANGULAR COORDINATE SYSTEM, GRAPHS OF LINEAR EQUATIONS, SLOPE

LEARNING OBJECTIVES

By the time you finish this module, you should be able to:

- □ Identify the x-axis, y-axis, origin, and Quadrants I, II, III, and IV on a coordinate grid.
- □ Plot any point on the coordinate grid, including points on the axes
- \Box Given the equation of any line, graph it by making a table.
- □ Recognize and graph the equation of any horizontal line and any vertical line.
- □ Recognize when a given equation is NOT linear, and graph it by making a table.
- \Box Find the x-intercept and the y-intercept of any linear equation.
- \Box Find the slope of any line by looking at the graph.
- \Box Find the slope of any line if you know two points.
- \Box Identify the slope of horizontal and vertical lines.
- \Box Graph a line when you are given a point and a slope.
- \Box Graph a line when you are given its equation in Slope-Intercept (y = mx + b) form.
- \Box Write any linear equation in Slope-Intercept (y = mx + b) form.

IMPORTANT INFORMATION FROM MODULE 3:

The x-axis is the horizontal axis, and the independent variable. The y-axis is the vertical axis, and the dependent variable. Every point has an x-coordinate and a y-coordinate written as an ordered pair (x,y). The origin has coordinates (0,0).

Points on the x-axis are called x-intercepts, and their y-coordinate is 0. (3, 0), (2, 0), etc. To find the x-intercept, plug 0 in for y and find the x-value that goes with it.

Points on the y-axis are called y-intercepts, and their x-coordinate is 0. (0, 3), (0, 2), etc. To find the y-intercept, plug 0 in for x and find the y-value that goes with it.

The equation y = a number is always horizontal. The slope of a horizontal line is 0. The equation x = a number is always vertical. The slope of a vertical line is undefined.

SLOPE: Given any two points (x_1, y_1) and (x_2, y_2) , the slope of the line containing them is $m = \frac{y_2 - y_1}{x_2 - x_1}$. Slope is also $\frac{rise}{run}$, or the rate of change.



Adult Learning Academy Elementary Algebra Workbook MODULE 3 VIDEO & EXERCISE LIST



Торіс	Website	Videos	Exercises
Plotting Points	www.khanacademy.org	Descartes & Cartesian Coordinates	Graphing Points
		The Coordinate Plane	Graphing Pts & Naming Quad.
		Plot Ordered Pairs	Points on the Coordinate Plane
		Quadrants of Coordinate Plane	
Points & Equations	www.khanacademy.org	Ordered Pair Solutions of Eq 2	Ordered Pair Sol's to Linear Eq.
		Plotting (x,y) Relationships	Identifying Linear Relationships
		Graphs of Linear Equations	
		Application Problem with Graph	
		Interpreting Linear Graphs	
		Exploring Linear Relationships	
		Recognizing Linear Functions	
		Graphing Lines 1	
Intercepts	www.khanacademy.org	Graphing Using x and y Intercepts	Solving for the X-Intercept
		Graphing Using Intercepts	
		X and Y Intercepts	
		X and Y Intercepts 2	
Horizontal & Vertical	http://www.youtube.com/watch?v=KwBE2pJDWvU	Horizontal and Vertical Lines	
	http://www.youtube.com/watch?v=VMitkRc5jHA	Horizontal and Vertical Lines	
Slope	www.khanacademy.org	Slope of a Line	Identifying Slope of a Line
		Slope of a Line 2	Line Graph Intuition
		Slope and Rate of Change	
		Graphical Slope of a Line	
		Slope of a Line 3	
		Slope and y-intercept Intuition	
Slope-Intercept Form	www.khanacademy.org	Graph Line in Slope-Intercept Form	Graphing Linear Equations
		Converting to Slope-Intercept Form	Slope-Intercept Form
		Linear Eq in Slope-Intercept Form	

Торіс	Website	Videos	Exercises
Slope-Intercept Form	www.khanacademy.org	Graphs Using Slope-Intercept Form	
(Cont.)		Equation of a Line 1	
		Equation of a Line 2	
Module 3 Test Review	www.stlcc.edu	Blackboard PowerPoint	Ten-Second Graphing
		Blackboard PowerPoint	Ten-Second Graphing Version 2
		Blackboard PowerPoint	Module 3 Review Flashcards



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Adult Learning Academy Elementary Algebra Workbook 3.1 POINT-PLOTTING PRACTICE



There are 4 parts to this picture.

What do you see? Plot the points on the left hand side to find out!

1. Plot these points and connect them in order:

(6, 8) (5, 6) (6, 4) (2, -4) (0, -5) (-1, -6) (-2, -9) (-1, -11) (0, -12)

(0, -13) (-3, -12) (-3, -11) (-4, -9) (-4, -6) (-6, -9) (-8, -11) (-8, -12)

(-1, -14) (-7, -14) (-10, -13) (-10, -11) (-8, -9) (-6, -3) (-5, 1) (-3, 3)

(2, 6) (2, 10) (3, 11) (5, 12) (9, 10) (9, 9) (6, 9) (9, 8) (8, 7) (6, 8)

2. Plot these points and connect them in order:

(5.5, 3) (7, 3) (7, 2) (5, 2)

3. Plot these points and connect them in order:

(3, 3) (5, 1) (7, 1) (7, 0) (4, 0)(2, 2)

4. Plot these points and connect them in order:

(2, -4) (3, -11) (4, -12) (4, -13) (1, -12) (1, -11) (0, -5)





Adult Learning Academy Elementary Algebra Workbook 3.2 GRAPHING PRACTICE



Make a table and plot points to graph the equations.

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



Make a table and plot points to graph the equations.

7.
$$x - y = 1$$

8.
$$y = -2x + 3$$



Special Lines: Horizontal, Vertical

Question: Where does a 3,000-pound rhinoceros sleep? **Answer:** Anywhere it wants to!









A Horizontal line ALWAYS has the equation y = a number

14. x = 5





A Vertical line ALWAYS has the equation **x = a number**









24.
$$y = -2x + 1$$

25.
$$y = \frac{3}{5}x$$

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



Module 3: The Rectangular Coordinate System, Graphs of Linear Equations, Slope

33. Point (3, 1) Slope ¹/₂

34. Point (-4, 1) Slope
$$-\frac{2}{3}$$

35. Point (0, 0) Slope $\frac{1}{3}$





37. Point (-4, 0) Slope -2



38. Point (-2, 3) Slope 0



41. Point (-1, 0) Slope 1





Adult Learning Academy Elementary Algebra Workbook 3.3 SLOPE PRACTICE

b.



1. Slope practice: What is the slope of each line below?







2. **Calculate the slope** of the line containing each pair of points. Graph each line.

Slope $=\frac{rise}{run} =$	$\frac{\text{the change in } y}{\text{the change in } x} =$	$\frac{y_{2-y_1}}{x_{2-x_1}}$
run	the change in x	$x_{2} - x_{1}$





Adult Learning Academy Elementary Algebra Workbook 3.4 PRACTICE WITH SLOPE-INTERCEPT FORM



Slope-Intercept Form y = mx + b

Rewrite each equation in slope-intercept form and graph the line.

	EQUATION	SLOPE-INTERCEPT FORM	SLOPE	Y-INTERCEPT	GRAPH
А.	3x + 2y = 6			(0,)	
В.	-2x + y = 4			(0,)	
C.	x + 2y = 3			(0,)	
D.	x - 2y = 5			(0,)	
E.	y - 3x = 0			(0,)	
F.	3x + y = 0			(0,)	
G.	$y - 4 = \frac{1}{2}(x + 6)$			(0,)	
H.	$\mathbf{x} - \mathbf{y} = 2$			(0,)	

Module 3: The Rectangular Coordinate System, Graphs of Linear Equations, Slope

	EQUATION	SLOPE-INTERCEPT FORM	SLOPE	Y-INTERCEPT	GRAPH
I.	y + 3 = 2(x - 1)			(0,)	
J.	5x - 3y = 15			(0,)	
К.	Slope is – ¾ y-intercept is 5			(0,)	
L.	Slope is 0 y-intercept is -2			(0,)	
М.	Vertical line Through (-5, 1)			(0,)	
N.	Horizontal line through (3, 1)			(0,)	
0.	Through the points (1, 5) and (-2, 3)	You'll learn to create the equation for this line in the next module! For now, can you graph it?	Estimate if necessary	(0,)	
P.	Through the points (3, 0) and (-1, 4)	You'll learn to create the equation for this line in the next module! For now, can you graph it?	Estimate if necessary	(0,)	





- 1. Carefully graph each to create a design below:
 - a. $y = \frac{3}{2}x + 8$
 - b. The line through the point (-6, 1) with slope $\frac{-3}{2}$
 - c. y = 4
 - d. The line through the point (2, -4) with a slope of 0.
 - e. $y = \frac{3}{2}x 8$
 - f. 3x + 2y = 16



2. Carefully graph each to create a design below:

a.
$$x + y = 8$$

b.
$$y = x + 8$$

c.
$$y = 8$$

d.
$$y = 3 - x^2$$




Adult Learning Academy Elementary Algebra Workbook 3.6 CAREER APPLICATIONS: STEM



Remember function notation from Module 2? Believe it or not, f(x) is just another way of saying "y"! Any equation that starts with y = mx + b could also be written as f(x) = mx + b. The advantage of the f(x) notation is that you can tell exactly what number to substitute in for x!

1. Forensic scientists can approximate a person's height by measuring the person's femur, which is the long bone that stretches from the hip socket to the kneecap. The relationship can be expressed as a function:

For females:

f(x) = 2.3x + 61	where x is the length of the femur in cm, and $f(x)$ is the woman's height in centimeters.
For males:	
m(x) = 2.2x + 69	where x is the length of the femur in cm, and $m(x)$ is the man's height in centimeters

a. Fill in the tables:

WOMAN			
Length of femur,	Height in cm,		
Х	f(x)		
40 cm			
45 cm			
50 cm			
55 cm			

MAN			
Length of femur,	Height in cm,		
Х	f(x)		
40 cm			
45 cm			
50 cm			
55 cm			

b. Graph it!



- c. What is the slope and the f-intercept for the women's equation?
- d. What is the slope and they m-intercept for the men's equation?
- 2. The dose for a particular medication is 5 milliliters per kilogram that the patient weighs. This relationship can be expressed as the function d(x) = 5x, where d is the dose in milliliters and x is the weight of the patient in kilograms.

Weight in kilograms, x	Dose in milliliters, d(x)
Baby, 5 kg	
Child, 20 kg	
Woman, 50 kg	
Man, 60 kg	

a. Calculate the dose for patients whose weights are listed:

- b. What is the slope of this line? What is the d-intercept?
- c. What does the slope mean in this problem? Why is it positive?
- d. If we graphed this line, we would only show points in the first quadrant. Why?

3. In Module 2, you worked with the formula for converting Celcius temperature to Fahrenheit. Now you can see that this formula is a linear equation!

$$F = \frac{9}{5}C + 32$$

You can also write the fraction as a decimal, so the formula becomes

$$F = 1.8C + 32$$

- a. What is the slope of the equation? What is its F-intercept?
- b. Fill in the table:

C°	F°
0	
10	
20	
30	

c. Sketch the graph:



4. Remember the problem from Module 2 about how long it costs to take courses at St. Louis Community College? Now you can recognize that function as a linear equation!

St. Louis Community College charges \$101 per credit hour, plus \$12 in fees. If x = the number of credit hours a student takes, and y = total paid, the following function describes the situation:

$$y = 101x + 12$$

- a. What is the y intercept of this line? What does it tell you?
- b. What is the slope of the line? Why is it positive?
- c. The line for this problem should only be graphed in the first quadrant. Why?
- d. Graph it! Choose an appropriate scale for the x-axis and the y-axis.



5. Remember the cricket problem from Module 2? You can now recognize the function as a linear equation!

It has been observed that the number of chirps a cricket makes per minute depends on the air temperature! Here is the function relating the temperature in degrees Fahrenheit, x, to the number of chirps, y.

y = 4x - 160

- a. What is the slope of this line? Why is it positive?
- b. What is the x-intercept of the line? What does it tell you?
- c. Why does this graph make the most sense in the first quadrant?
- d. Graph it! Choose an appropriate scale for the x-axis and the y-axis.





<u>3.1 Point-Plotting Practice</u>

A tyrannosaurus rex



3.2 Graphing Practice



Module 1: Expressions, Equations, and Inequalities



3.2 Graphing Practice (cont.)



Graphs are approximate.

3.3 Slope Practice

1a. -1/3

1b. 2/3

1c. 1/2

1d. -1/2

1e. 0

1f. Undefined

Graphs are approximate!



3.4 Slope-Intercept Form

	SI FORM	SLOPE	Y-INT.	GRAPH
A.	y = -3/2 x + 3	m = -3/2	(0, 3)	
В.	$\mathbf{y} = \mathbf{2x} + 4$	m = 2	(0, 4)	
c.	y = -1/2x + 3/2	m = -1/2	(0, 3/2)	
D.	y = 1/2x - 5/2	m = 1/2	(0, -5/2)	
E.	$\mathbf{y} = 3\mathbf{x}$	m = 3	(0, 0)	
F.	y = -3x	m = -3	(0, 0)	
G.	$\mathbf{y} = \frac{1}{2} \mathbf{x} + 7$	m = 1/2	(0, 7)	
Н.	$\mathbf{y} = \mathbf{x} - 2$	m = 1	(0, - 2)	

	SI FORM	SLOPE	Y-INT.	GRAPH
I.	$\mathbf{y} = \mathbf{2x} - 5$	m = 2	(0, - 5)	
J.	$\mathbf{y} = 5/3\mathbf{x} - 5$	m = 5/3	(0, - 5)	
К.	y = -3/4 x + 5	m = -3/4	(0, 5)	
L.	y = -2	m = 0	(0, - 2)	
М.	x = -5	undefined	n/a	
N.	y = 1	m = 0	(0, 1)	
0	You'll learn to create the equation for this line in the next module!	m = 2/3	Estimate if necessary	
Р.	You'll learn to create the equation for this line in the next module!	m = -1	Estimate if necessary	

3.5 Line Designs!



3.6 Career Applications – STEM

1a.

WOMAN			
Length of F	Height in cm,		
Х	f(x)		
40 cm	153 cm		
45 cm	164.5 cm		
50 cm	176 cm		
55 cm	187.5 cm		

MAN		
Length of F	Height in cm,	
Х	f(x)	
40 cm	157 cm	
45 cm	168 cm	
50 cm	179 cm	
55 cm	190 cm	



<u>3.6 Career Applications – STEM (cont.)</u>

2a.	Weight in kg x	Dose in mL d(x)
	Baby, 5 kg	d(5) = 5(5) = 25
	Child, 20 kg	d(20) = 5(20) = 100
	Woman, 50 kg	d(50) = 5(50) = 250
	Man, 60 kg	d(60) = 5(60) = 300

- **2b.** m = 5, d-intercept = 0
- **2c.** for every kilogram you add in weight, the dose increases by 5 milliliters; the slope is positive because as weight increases, so does size of the dose
- 2d. Weight and doses are non-negative quantities

3a. m = **1.8**, **F**-intercept = **32**



- **4a.** y-int. = 12; this tells you the fee, regardless of the number of credit hours
- **4b.** m = 101, this number is positive because as credit hours increase, so does the cost
- 4c. Both credit hours and fees are positive quantities

3.6 Career Applications – STEM (cont.)



- **5a.** m = 4; slope is positive because the higher the temperature, the faster they chirp
- **5b.** x-intercept = 40; this tells you that crickets stop chirping at 40 degrees
- **5c.** The number of chirps must be positive, and crickets aren't out in negative temperatures





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Adult Learning Academy Elementary Algebra Workbook



MODULE 4: EQUATIONS OF LINES, GRAPHS OF LINEAR INEQUALITIES, SOLVING SYSTEMS BY GRAPH

LEARNING OBJECTIVES

By the time you finish this module, you should be able to:

- Given a point and a slope, graph and write the equation of the line.
- □ Given two points, graph and write the equation of a line containing them.
- □ Write the equation of a line in standard form, in point-slope form, and in slope-intercept form.
- □ Graph a system of two equations and find the solution by locating their intersection.
- □ Recognize and graph parallel lines.
- □ Recognize and graph perpendicular lines.
- □ Find the slope of parallel and perpendicular lines.
- □ Graph linear inequalities by shading.

IMPORTANT INFORMATION FROM MODULE 4:

SLOPE: Given any two points (x_1, y_1) and (x_2, y_2) , the slope of the line containing them is $m = \frac{y_2 - y_1}{x_2 - x_1}$.

SLOPE-INTERCEPT FORM OF A LINEAR EQUATION: y = mx + b, where *m* is the slope and *b* is the y-intercept.

POINT-SLOPE FORM OF A LINEAR EQUATION: $y - y_1 = m(x - x_1)$, where *m* is the slope and (x_1, y_1) is a point on the line.

STANDARD FORM OF A LINEAR EQUATION: Ax + By = C, where *A*, *B*, and *C* are constants.

PARALLEL LINES have equal slopes.

PERPENDICULAR LINES have opposite, reciprocal slopes.

TO GRAPH A LINEAR INEQUALITY: 1) draw the border line solid for > or <, dotted for > or <; 2) test a point not on the line; 3) shade the "good" side of the line



Adult Learning Academy Elementary Algebra Workbook MODULE 4 VIDEO & EXERCISE LIST



Торіс	Website	Videos	Exercises
Forms of Linear Equations	www.khanacademy.org	Linear Equations in Point Slope Form	Point Slope Form
		Linear Equations in Standard Form	Converting Pt-Slope, Std. Form
		Point-Slope and Standard Form	Converting Pt-Slope, Slope-Int.
			Finding the Equation of a Line
	www.stlcc.edu	Blackboard PowerPoint	Write the Equation!
Parallel and Perpendicular	www.khanacademy.org	Perpendicular Line Slope	Eq. of Parallel and Perp Lines
Lines		Equations of Perp & Parallel Lines	
		Parallel Lines	
		Parallel Lines 2	
		Parallel Lines 3	
		Perpendicular Lines	
		Perpendicular Lines 2	
Graphing Inequalities	www.khanacademy.org	Graphing Inequalities	Graphs of Inequalities
		Solving & Graphing Lin Inequalities 1	Graphing Linear Inequalities
		Solving & Graphing Lin Inequalities Ex 2	Graphing & Solving Linear Ineq.
		Graphing Inequalities 2	
		Graphing Inequalities 3	
Application	www.khanacademy.org	Super-Yoga Plans: Basic Variables, Equations	
		Super-Yoga Plans: Solving 1-step equations	
		Super-Yoga Plans: Plotting Pts	
Module 4 Test Review	www.stlcc.edu	Blackboard PowerPoint	Write the Equation
			Module 4 Review Flashcards

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Adult Learning Academy Elementary Algebra Workbook 4.1 HOW TO WRITE THE EQUATION OF A LINE



Standard Form:	Slope-Intercept Form:	Point-Slope Fo	rm: Slope Formula:
Ax + By = C	$\mathbf{y} = \mathbf{m}\mathbf{x} + \mathbf{b}$	$\mathbf{y} - \mathbf{y}1 = \mathbf{m}(\mathbf{x} - \mathbf{x})$	x1) $\mathbf{m} = \frac{y_{2-y_1}}{x_{2-x_1}}$
If you know the SLOPE and the Y-INTERCEPT, us the SLOPE-INTERCEPT FORM	te If you know the SLOPE and the POINT-SLO	l any old POINT, use PE FORM	If you know 2 POINTS that are on the line, use them to find the SLOPE. Then pick one of the points and use the POINT-SLOPE FORM
 1a. Write the equation of a line with a slope of -¹/₂ and y-intercept at (0, 3). 	2a. Write the equation of -1/2 that passes through	a line with a slope of h the point (4, 7)	3a. Write the equation of a line that contains the points (3, 7) and (-2, 1).
1b. Write the equation of a line with a slope of ³ / ₄ and y-intercept at (0, -2).	f 2b. Write the equation of ³ / ₄ that passes through	a line with a slope of the point (-2, 5)	3b. Write the equation of a line that contains the points (0, 5) and (2, -3).



Adult Learning Academy Elementary Algebra Workbook 4.2 PARALLEL AND PERPENDICULAR LINES



- 1. Using a ruler, carefully graph each of these lines on the one coordinate system below. What do you notice?
- 2. PARALLEL lines never intersect (cross). Parallel lines have equal slopes. Determine if each pair of lines below is parallel.

a.	y = -3x + 1	and	y = -3x - 4	Are they parallel?
b.	y = 3x + 5	and	y = 2x + 5	Are they parallel?
c.	y = 3x + 5	and	y = -3x + 2	Are they parallel?
d.	x + y = 5	and	x + y = 10	Are they parallel?
e.	2x + 3y = 6	and	y = -2/3 x + 4	Are they parallel?
f.	x = 5	and	y = 5	Are they parallel?

4.2 PARALLEL AND PERPENDICULAR LINES (CONT.)

3. Using a ruler, carefully graph each of these lines on the one coordinate system below. What do you notice?



4. PEPENDICULAR lines intersect (cross) at a right angle (90 degrees). Perpendicular lines have OPPOSITE (one positive, one negative), RECIPROCAL (upside-down fractions) slopes.

For example, if one line has a slope of $\frac{1}{3}$, a line perpendicular to it would have slope $\frac{-3}{1}$ or -3.

For each pair of equations below, circle whether the two lines are **parallel** (same slope), **perpendicular** (opposite reciprocal slopes), or **neither**.

a.	y = -3x + 1	and	y = -3x - 4	Parallel	Perpendicular	Neither
b.	y = 3x + 5	and	y = 2x + 5	Parallel	Perpendicular	Neither
c.	$y = \frac{2}{3}x + 5$	and	$y = \frac{-3}{2}x + 2$	Parallel	Perpendicular	Neither
d.	y = 4x + 1	and	y = -4x + 1	Parallel	Perpendicular	Neither
e.	y = 4x + 1	and	$y = \frac{-1}{4} x$	Parallel	Perpendicular	Neither
f.	3x + 2y = 6	and	$y = \frac{2}{3}x + 4$	Parallel	Perpendicular	Neither
g.	x = 5	and	y = 5	Parallel	Perpendicular	Neither

4.2 PARALLEL AND PERPENDICULAR LINES (CONT.)

In each problem, you are given the equation of a line. Create the equation for any line parallel to the first line, and the equation for any line perpendicular to the first line. Finally, graph all three lines on the same coordinate system.





- Original line: $y = \frac{1}{4}x 2$
 - a. Parallel line: _____
 - b. Perpendicular line: _____
 - c. Graph all three lines to the left.





A "system" of equations is just more than one equation that must be true at the same time.

For example, here is a system of two equations: $\mathbf{x} + \mathbf{y} = \mathbf{7}$ $2\mathbf{x} + \mathbf{y} = \mathbf{10}$

There are infinitely many solutions to the equation x + y = 7. For example, the points (0, 7), (1, 6), (2, 5), (3, 4), (4, 3), (5, 2), (6, 1), (7, 0), (8, -1), and (9, -2) all satisfy the equation and are on the line x + y = 7.

Similarly, there are infinitely many solutions to the equation 2x + y = 10. For example, the points (0, 10), (1, 8), (2, 6), (3, 4), (4, 2), (5, 0), (6, -2), (7, -4), and (8, -6) all satisfy the equation and are on the line 2x + y = 10.

To solve the SYSTEM of equations means to find the point that satisfies BOTH equations in the system. In other words, we are looking for a point that is on BOTH lines. It's where the lines INTERSECT (cross)!

1. Graph the lines $\mathbf{x} + \mathbf{y} = \mathbf{7}$ and $\mathbf{2x} + \mathbf{y} = \mathbf{10}$ below and see if you can find the point where they cross. That's the solution to the system. In future courses you will even learn how to find this point without graphing!



4.3 SYSTEMS OF EQUATIONS (CONT.)

Use a ruler to carefully graph each pair of lines on the one coordinate system and find their intersection. The point of intersection is the solution to the system of equations.



$$y = \frac{1}{2} x - 1$$

 $y = -x - 7$

Check by plugging the x and y coordinates of your solution into each equation. They should both be satisfied! Did you find the x and y values that make BOTH equations true?

 $\mathbf{y} = \mathbf{x} - \mathbf{7}$

$$\mathbf{y} = -\mathbf{x} + \mathbf{3}$$

Does your solution check?



What do you notice about these lines? Where do they cross?



Adult Learning Academy Elementary Algebra Workbook 4.4 GRAPHING LINEAR INEQUALITIES





RECIPE for graphing linear inequalities:

- 1. Temporarily pretend that there is an equal sign.
- 2. Graph the border line: use a solid line for \geq or \leq , use a dotted line for > or <.
- 3. Choose a test point NOT on the border. Most people choose (0, 0) as long as it's not on the border.
- 4. Plug the x-coordinate and the y-coordinate of the test point into the original inequality. If the point satisfies the inequality, then shade the side containing that point. If the point does NOT satisfy the inequality, then shade the other side.

4.4 GRAPHING LINEAR INEQUALITIES (CONT.)

g.
$$y < \frac{1}{4}x - 2$$

h. y > 3x

i. $y \le \frac{1}{2}x + 3$





Adult Learning Academy Elementary Algebra Workbook 4.5 POINT-SLOPE FORM SONG



POINT-SLOPE FORM

(to the tune of Ghostbusters), lyrics by Debbie Char

When you've got a point And you know the slope, Whatcha gonna use? POINT-SLOPE FORM!!!

When you've got TWO points, You can find the slope, then Whatcha gonna use? **POINT-SLOPE FORM!!!**

Y minus Y₁, which is the y-coordinate, Equals m, which is the slope, then in parentheses X minus X₁, which is the x-coordinate, That's the Point-Slope form of the equation of a line!



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Adult Learning Academy Elementary Algebra Workbook 4.6 POINT-SLOPE FORM PRACTICE



$\mathbf{y} - \mathbf{y}_1 = \mathbf{m}(\mathbf{x} - \mathbf{x}_1)$

	WHAT YOU KNOW	EQUATION IN POINT-SLOPE FORM	SKETCH GRAPH
	G1 1/		
	Slope $m = \frac{1}{2}$		
А.	Point (3, 1)		
	1 01110 (0, 1)		
	01 1/		
R	Slope $m = \frac{1}{2}$		
р.	Point (3, 1)		
	/		
	G1 1/		
C	Slope $m = \frac{1}{2}$		
C.	Point $(3, 1)$		
	1 onn (3, 1)		
	Slope $m = \frac{1}{2}$ Point (3, 1)		
n			
D .			
F			
	G1 1/		
	Slope $m = \frac{1}{2}$		
L'.	Point $(3, 1)$		

4.6 POINT-SLOPE FORM PRACTICE (CONT.)

	WHAT YOU KNOW	EQUATION IN POINT-SLOPE FORM	SKETCH GRAPH
F.	Slope $m = \frac{1}{2}$ Point (3, 1)		
G.	Slope $m = \frac{1}{2}$ Point (3, 1)		
H.	Slope $m = \frac{1}{2}$ Point (3, 1)		
		Equation in <u>SLOPE-INTERCEPT</u> Form (y = mx +b)	
I.	Slope $m = \frac{1}{2}$ Point (3, 1)		
J.	Slope $m = \frac{1}{2}$ Point (3, 1)		



Adult Learning Academy Elementary Algebra Workbook 4.7 CAREER APPLICATIONS: STEM



- 1. A farmer starts with 40 acres, and plants two additional acres each year.
 - a. Graph the number of acres planted over the years. Why is it only shown in the first quadrant?



- b. What is the slope of this line? Why is it positive? What is the y-intercept?
- c. Write the equation of the line. What form of the linear equation did you choose?
- d. Another farmer starts at 44 acres, and also plants 2 additional acres each year. Make this line in another color on the same graph.
- e. Write the equation for the second farmer's acres planted. What do you notice about the two lines? How can you tell that this is true from their equations?
- f. A third farmer starts with 40 acres planted, but each year plants 3 more. Graph her line in a third color.
- g. Compare this new line with the other two. What is the same? What is different? Explain what you see.
- h. If all three farmers continue in their patterns for 30 years, how much will each be planting in their 30th year?

- 2. A generous long-term grant gives a research team \$100 million. Each year they spend 5 million dollars of the grant.
 - a. Graph the amount left on the grant over the first six years:



- b. What is the slope of this line? Is it positive or negative? Why?
- c. Write the equation for the line. What form did you choose?
- d. Another lab received a grant for \$80 million, and will also use \$5 million per year. Write the equation for the amount of money left in the grant each year, and graph it in another color above. What can you say about the two lines?
- e. A third lab received a grant for \$100 million, but will use \$10 per year. Write the equation for its value over time, and graph it in another color above. Compare this equation to the others. What is the same? What is different?
- f. After 10 years, how much of each grant will remain?

- 3. A researcher who has been with the lab 5 years makes \$55,000 per year. A researcher who has been with the lab 7 years makes \$65,000 per year.
 - a. Use the two points described above to graph a line:



- b. What is the slope of this line?
- c. Write the equation of the line. What form did you use?
- d. According to your equation, how much would a researcher make annually after working 25 years?
- e. According to your equation, how much would a starting researcher make?

- 4. A lab can hire a maximum of 20 technicians. Some can be part-time and others can be full-time. If x = the number of part-timers and y = the number of full-timers, the inequality $x + y \le 20$ describes the situation.
 - a. Graph all possible combinations of part-time and full-time drivers:
 - b. Can the lab hire 10 part-time and 10 full-time technicians? Where is this point?



- 5. The Human Resources Department at work offers you a choice of two prescription drug plans. Plan A charges \$50 per year plus \$10 per prescription filled. Prescription Plan B charges \$25 per year plus \$15 per prescription filled.
 - a. Graph and label each equation.

$$A(x) = 50 + 10x
B(x) = 25 + 15x$$
Cost in dollars
$$\begin{cases}
125 \\
100 \\
575 \\
550 \\
125 \\
122 \\
325 \\
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324 \\
56 \\
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b. Where do the two lines cross? Interpret the meaning of that point.



Adult Learning Academy Elementary Algebra Workbook MODULE 4 ANSWER KEY

OR y - 1 = 6/5(x + 2)

y + 3 = -4(x - 2)



4.1 How to Write the Equation of a Line

1a. $y = -1/2x + 3$	3a. $m = \frac{1-7}{-2-3} = \frac{-6}{-5} = 6/5$
1b. $y = 3/4x - 2$	y - 7 = 6/5(x-3) OR
2a. $y - 7 = -1/2 (x - 4)$	3a. $m = \frac{-3-5}{2-0} = \frac{-8}{2} = -4$
2b. $y - 5 = \frac{3}{4} (x + 2)$	y - 5 = -4x OR y + 3

4.2 Parallel and Perpendicular Lines



4a. Parallel 4b. Neither

4c. Perpendicular

4d. Neither

- 4e. Perpendicular
- 4f. Perpendicular
- 4g. Perpendicular
- 5a. may vary: $y = \frac{1}{4}x + 3$ (slope must equal ¹/₄)
- **5b.** may vary: y = -4 x + 1 (slope must equal -4)
- 5c.



6b. may vary: y = 3/2 x - 1 (slope must equal 3/2)





4.3 Systems of Equations





<u>4.4 Graphing Linear Inequalities</u>



4.6 Point-Slope Practice (cont.)



4.7 Career Applications: STEM

1a. Acres and time only make sense in positive quantities



- **1b.** m = 2, y-int. = 40; slope is positive because the more years go by, the more acres are planted
- **1c.** slope-intercept form y = 2x + 40
- 1d. see graph above
- **1e.** y = 2x + 44; lines a and d are parallel because they have the same slope
- 1f. y = 3x + 40
- **1g.** has same y-intercept as line a, but has steeper incline
- **1h.** y = 2(30) + 40 = 100 acres
 - y = 2(30) + 44 = 104 acres
 - y = 3(30) + 40 = 130 acres



2b. m = -5/1; as years increase, money decreases
2c. slope-intercept form y = -5x + 100



- **2d.** y = -5x + 80; lines a and c are parallel because they have the same slope
- **2e.** y = -10x + 100; same y-intercept as line a but steeper decline
- **2f.** y = -5(10) + 100 =**\$50 million left** y = -5(10) + 80 =**\$30 million left** y = -10(10) + 100 =**\$0 left**



3b.
$$\mathbf{m} = \frac{65,000 - 55,000}{7 - 5} = \frac{10,000}{2} = 5,000$$

- **3c.** point slope form y 65, 000 = 5,000(x 7) OR point slope form y - 55, 000 = 5,000(x - 5) OR slope-intercept form y = 5000x + 30,000
- 3d. y = 5000(25) + 30,000 = \$155,000
- 3e. y = 5000(0) + 30,000 = \$30,000



- 4b. Yes, the point is on the line
- 4c. Yes, this point is in the shaded area
- 4d. No, this point is not in the shaded area

4.7 Career Applications: STEM (cont.)

plan





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Adult Learning Academy Elementary Algebra Workbook



MODULE 5: INTEGER EXPONENTS & LAWS, SCIENTIFIC NOTATION, POLYNOMIALS & OPERATIONS

LEARNING OBJECTIVES

By the time you finish this module, you should be able to:

- □ Simplify expressions involving positive or negative exponents according to the exponent rules
- □ Convert a number in standard notation into scientific notation
- □ Convert a number in scientific notation into standard notation
- □ Identify a monomial, binomial, trinomial, and polynomial
- □ Sort polynomials according to their degree
- □ Add, subtract, and multiply polynomials of any size
- \Box Divide a polynomial by a monomial

IMPORTANT INFORMATION FROM MODULE 5:

 $x^m \cdot x^n = x^{m+n}$

 $(x^m)^n = x^{mn}$ "when you raise a power to a power, mutiply the powers"

$$\frac{x^m}{x^n} = x^{m-n}$$

 $x^0 = 1$, $0^m = 0$, 0^0 is undefined

 $\left(\frac{x}{y}\right)^m = \frac{x^m}{y^m}$ $x^{-m} = \frac{1}{x^m}$ A negative exponent does NOT make a number negative!

one term: monomial; two terms: binomial; three terms: trinomial

To find the degree of a single term, add all the exponents on all the variables in that term. To find the degree of a polynomial, have a contest: the term with the highest degree wins!

FOIL: for multiplying a binomial times a binomial (also for squaring a binomial!!) $(a+b)^2 = a^2 + 2ab + b^2$ $(a-b)^2 = a^2 - 2ab + b^2$ $(a+b)(a-b) = a^2 - b^2$

Birthday Song: You must have like terms, you must have like terms — to ADD or SUBTRACT, you must have like terms!

When you subtract a polynomial, be sure to subtract EVERY term!!



Adult Learning Academy Elementary Algebra Workbook MODULE 5 VIDEO & EXERCISE LIST



Торіс	Website	Videos	Exercises
Exponents	www.khanacademy.org	Level 1 Exponents	Positive and Zero Exp
		Understanding Exponents 2	Negative Exponents
		Understanding Exponents	Exponent Rules
		Level 2 Exponents (negative exp)	
		Exponent Rules Part 1	
		Exponent Rules Part 2	
		Exponent Prop involving Quotients	
	www.stlcc.edu	Exponent Rules ppt on Blackboard	
	http://www.youtube.com/watch?v=h063AzwjGlc	Mathman: 3 Exponent Mistakes	
Scientific Notation	www.khanacademy.org	Scientific Notation	Scientific Notation
		Scientific Notation 1	
Polynomials	http://www.youtube.com/watch?v=D-3NIysYshM	Diff betw Trinom, Bi, Monomial	
	http://www.youtube.com/watch?v=l_kY3sHViSA	Identifying Degree, Name of Polyn.	
	www.khanacademy.org	Tems Coefficients and Exponents	
		Evaluating a Polynomial at a Given Value	
		Simplify a Polynomial	
Add, Subt. Polynom.	www.khanacademy.org	Adding Polynomials	Adding, Sub Polynom.
		Ex: Adding Polynomials w/Mult Var.	
		Add & Subt of Polynomials	
		Adding and Sub Polynomials 1	
		Adding & Subt Polynomials 2	
		Adding and Sub Polynomials 3	
		Subtracting Polynomials	
		Sub Polynomials w/ Mult Variables	

Торіс	Website	Videos	Exercises
Multiplying Polynom.	www.khanacademy.org	Multiplying Monomials	Multip. Express. 0.5
		Multiplying Monomials by Polynom.	Multiplying Exp. 1
		Multiplying Binomials	Multiplying Polynom.
		Multiplying Polynomials1	
		Multiplication of Polynomials	
		Square a Binomial	
		Special Products of Binomials	
		Special Polynomials Products 1	
		Special Products of Polynomials 1	
		Special Products of Polynomials 2	
		Multiplying Polynomials	
		More Multiplying Polynomials	
Dividing Polynomials	www.khanacademy.org	Polynomial Divided by Monomial	
		Dividing Multivariable Poly. w/ Mono	
Module 5 Test Review	www.stlcc.edu	Blackboard PowerPoint	Exponent Rules
			Module 5 Review Flashcards

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St. Louis Community College	Adult Learning Academy Elementary Algebra Workbook 5.1 SIMPLIFYING EXPRESSIONS	
	Simplify each expression:	
1. $x^6 \cdot x^2$	11. 5 ⁻²	22. $\left(\frac{5}{x}\right)^{-2}$
2. $x^6 + x^2$	12. 0 ⁵	12.4.8
3. $x^6 \div x^2$	13. 0 ⁰	23. $\frac{12x^{-}x^{-}}{4x^{3}}$
4. $(x^6)^2$	14. -5^{-2}	24. $\frac{-10x^5y^{-3}}{15x^{-3}y^2}$
5. $10x^8 \cdot 2x^2$	15. $(-5)^2$	
6. $(10x^8)^2$	16. (-5) ⁻²	25. $\frac{4x^7x^{-3}y^7}{4x^5y^6}$
7. $\frac{10x^8}{2x^2}$	17. $5x^{-2}$	26. $\left(\frac{7x^5y^{-2}}{14x^{-3}y^4}\right)^3$
8. $10x^8 - 2x^2$	18. $(5x)^{-2}$	
9. $10x^8 - 2x^8$	19. x^0	27. $\left(\frac{12x^{-2}y^4}{4x^{-3}y^{-3}}\right)^{-3}$
10. -5^2	20. $5x^0$	
	21. $(5x)^0$	

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Adult Learning Academy Elementary Algebra Workbook 5.2 COLOR MATCHING SIMPLIFIED EXPRESSIONS



Simplify each expression, and color the matching simplified expressions.




Adult Learning Academy Elementary Algebra Workbook 5.3 MULTIPLYING POLYNOMIALS



1. $x \cdot x$	11. $(x + 7)(x - 5)$	21. $(3x-5)^2$
2. $\mathbf{x} \cdot \mathbf{x}^2$	12. $(x + 7)(x - 5)$	22. $(2x + 7)^2$
3. $x^2 \cdot x^3$	13. $(x + 7)(x - 7)$	23. $(3x-5)(3x+5)$
4. $x^5 \cdot x^2$	14. $(x-5)(x+5)$	24. $(2x + 7)(2x - 7)$
5. $5x^3 \cdot -2x^4$	15. $(x + 7)^2$	25. $(x + y)(x - y)$
6. $-6x^5 \cdot -4x^3$	16. (x - 7) ²	26. $(x + y)^2$
7. $3x(4x^2 - 5x + 1)$	17. $(x + 5)^2$	27. $(x - y)^2$
8. $-2x^3(5x^4-3)$	18. $(x - 5)^2$	28. $(3x + 2y)(3x - 2y)$
9. $7x^2(x^3 - 3x + 2)$	19. $(3x + 5)(2x - 7)$	29. $(3x + 2y)^2$
10. $(x + 7)(x + 5)$	20. $(3x-5)(2x+7)$	30. $(3x - 2y)^2$



Adult Learning Academy Elementary Algebra Workbook 5.4 SCIENTIFIC NOTATION



Fill in the table:

Item	Scientific Notation	Standard Notation
Approximate number of hairs on your head		140,000
Number of cells in your brain		100,000,000,000
Length of a rhinovirus in meters		.000000020
Number of heartbeats in a lifetime	2.7 x 10 ⁹	
Speed that human hair grows in miles per hour	1.0 x 10 ⁻⁸	
Number of red blood cells in a human body	$3.0 \ge 10^{13}$	
Lung capacity of a blue whale in milliliters		5,000,000
Speed of a snail in kilometers per second		.000013
Thickness of a sheet of paper in inches	2.75 x 10 ⁻³	





Expression	CHOOSE: Monomial, Binomial, Trinomial, Polynomial	Degree
$3x^2 - 2x + 1$		
5xyz		
4x + 2y		
$5x^2y - 11$		
139		
$-642x^{39}$		
2y + 3x - 5w + p		
$57x^5 - 2x^3 + 11x$		
X		
$4x^2 + 3x + x$		
$2x + y + z^{12}$		
5x ⁰		
$100x^2 - py^3$		
3x + 2		
10x - y + z + p - 5		

- 1. Create a 2nd-degree trinomial:
- 2. Create a 4th-degree monomial:



3. Create a 3rd-degree binomial:

- 4. Can the sum of two binomials ever be a trinomial? If so, show an example:
- 5. Can the sum of two binomials ever be a monomial? If so, show an example:
- 6. Can the sum of two binomials ever be a binomial? If so, show an example:
- 7. Can the product of two binomials ever be a binomial? If so, show an example:
- 8. Can the product of two binomials ever be a trinomial? If so, show an example:
- 9. Can the product of two binomials ever have four terms? If so, show an example:



Adult Learning Academy Elementary Algebra Workbook 5.6 EVALUATING, ADDING, AND SUBTRACTING POLYNOMIALS



Here are three functions:

$$f(x) = 3x^2 - 2x + 1$$
 $g(x) = -2x^2 - 5$ $h(x) = -4x + 2$

To "evaluate" means to plug in the value of x and see what you get. When you plug in a negative number for x, always put parentheses around it!

- 1. Evaluate the following:
 - a) f(2) b) g(-3) c) h(0)
 - d) f(-5) e) g(0) f) h(-5)
- 2. When you add and subtract polynomials, combine like terms. When you subtract, be sure to subtract EVERY term!
 - a) f(x) + g(x) b) g(x) + h(x) c) f(x) + h(x)

d) f(x) - g(x) e) g(x) - h(x) d) f(x) - h(x)

- 3. You can also multiply every term of a polynomial by a number. Find these:
 - a) 4f(x) + 3g(x) b) 5f(x) 2h(x)



Adult Learning Academy Elementary Algebra Workbook 5.7 CAREER APPLICATIONS: STEM



1. The day's revenue (income) for a computer company depends on how many clients come to get their computers fixed. The revenue can be modeled by the function

 $R(x) = x^3 - x^2$ where R(x) is the revenue in dollars, and x is the number of clients that day

The day's costs (expenses) for the same company also depend on how many clients come to get their computers fixed. The costs can be modeled by the function

 $C(x) = .75x^3 - .7x^2 - .5x + 10$ where C(x) is the cost in dollars, and x is the number of clients that day

Any business calculates its PROFIT by starting with Revenue (income) and subtracting expenses (costs). So the profit function, P(x), can be modeled by

$$\mathbf{P}(\mathbf{x}) = \mathbf{R}(\mathbf{x}) - \mathbf{C}(\mathbf{x}).$$

a. For this company, what is the profit function? (subtract R(x) - C(x)):

- b. If 3 clients come to get their computers fixed on a given day, what is the Revenue? The Cost? The Profit?
- c. If 20 clients come to get their computers fixed on a given day, what is the Revenue? The Cost? The Profit?
- d. Say that Revenue doubles (get multiplied by 2), but costs remain the same. Show the new function for Profit:

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2. Write an algebraic expression for the PERIMETER (add all the sides) and the AREA (length times width) of each rectangle on the page. Remember that area is measured in square units.



3. Barnes-Jewish Hospital in St. Louis is 177 feet tall. If you stood at the top of the hospital and dropped a penny (NOTE: this is NOT recommended!), the following function tells you high off the ground the penny would be after t seconds:

$$h(t) = -16t^2 + 177$$

where t is the number of seconds since you dropped the penny, and h(t) is the penny's height in feet off the ground.



- a. Find h(0). What does this information tell you?
- b. Find h(1), the height of the penny 1 second after being dropped:
- c. Find h(2), the height of the penny 2 seconds after being dropped:
- d. Find h(3), the height of the penny 3 seconds after being dropped:
- e. Would the penny still be falling 4 seconds after being dropped? How do you know?



Adult Learning Academy Elementary Algebra Workbook MODULE 5 ANSWER KEY



5.1 Simplifying Expressions	5.2 Color Matching Expressions
1. x ⁸	$2^0 = \frac{3x}{2x} = 1$
2. not like terms	$\frac{3x}{2x} = (52x4 + 2) = (52x4 + 4) = 2x0$
3. x^4	$\frac{-1}{x} = (53x^2 + 3) - (53x^2 + 1) = 2x^3$
4. x ¹²	$-5^2 = 0x - 25 = -25$
5. 20x ¹⁰	x + x = 5x - 3x = 2x
6. 100x ¹⁶	
7. 5x ⁶	$100x^2 - 99x^2 = x \cdot x = x^2$
8. not like terms	$3x^2 - x^2 = \frac{10x^5}{5x^3} = 2x^2$
9. 8x ⁸	$\frac{5x^2}{x^3+x} = x^2 + 1 = (5x^2 - 1) - (4x^2 - 2) = x^2 + 1$
1025	$\frac{1}{x} = x^{2} + 1 = (5x^{2} - 1) - (4x^{2} - 2) = x^{2} + 1$
11. 1/25	$(x + 1)(x - 1) = (5x^2 - 2) - (4x^2 - 1) = x^2 - 1$
12.0	$(x+1)^2 = x^2 + 2x + 1$
13. undefined	$5x^2 - 10x + 5$
$14.\frac{-1}{25}$	$(x-1)^2 = \frac{5x-26x+6}{5} = x^2 - 2x + 1$
15. 25	5.3 Multiplying Polynomials
$16\frac{1}{-1}$	1. x ²
25	2. x^3
$17.\frac{5}{v^2}$	3. x ⁵
1	4. x ⁷
18. $\frac{1}{25x^2}$	510x ⁷
19.1	6. 24x ⁸
20. 5	7. $12x^3 - 15x^2 + 3x$
21. 1	8. $-10x^7 + 6x^3$
x^{2}	$9.\ 7x^5 - 21x^3 + 14x^2$
$22.\frac{1}{25}$	10. $x^2 + 12x + 35$
23. $3x^9$	11. $x^2 + 2x - 35$
$24 \frac{-2x^8}{x^8}$	12. $x^2 - 12x + 35$
$3y^5$	$13. x^2 - 49$
25. $\frac{y}{2}$	$14. x^2 - 25$
X	$15. x^2 + 14x + 49$
$26. \frac{\chi^{-1}}{8\chi^{18}}$	$16. x^2 - 14x + 49$
1	$17. x^2 + 10x + 25$ $18 x^2 - 10x + 25$
$27. \frac{-}{27x^3y^{21}}$	10. x - 10x + 23 $10. c^{2}$ 11 25
28. split up the fraction	$19. 0x^{2} - 11x - 35$
$\frac{x^4}{x^4} = \frac{x^3}{x^3} + \frac{2x}{5} = \frac{5}{5}$	$20. \ 0X^{-} + 11X - 35$
$3 - 5 + 3 - \frac{3}{3x}$	$21.9X^2 - 30X + 25$

Module 5: Integer Exponents and Laws, Scientific Notation, Polynomials and Operations

5.3 Multiplying Polynomials (cont.)

22. $4x^2 + 28x + 49$ 23. $9x^2 - 25$ 24. $4x^2 - 49$ 25. $x^2 - y^2$ 26. $x^2 + 2xy + y^2$ 27. $x^2 - 2xy + y^2$ 28. $9x^2 - 4y^2$ 29. $9x^2 + 12xy + 4y^2$ 30. $9x^2 - 12xy + 4y^2$

5.4 Scientific Notation

Item	Scientific Notation	Standard Notation
Number of hairs on your head	1.4 x 10 ⁵	140,000
Number of cells in your brain	1.0 x 10 ¹¹	100,000,000,000
Length of a rhinovirus in meters	2.0 x 10 ⁻⁸	.00000020
Number of heartbeats in a lifetime	2.7 x 10 ⁹	2,700,000,000
Speed that human hair grows in miles per hour	1.0 x 10 ⁻⁸	.00000001
Number of red blood cells in a human body	3.0 x 10 ¹³	30,000,000,000,000
Lung capacity of a blue whale in mL	5.0 x 10 ⁶	5,000,000
Speed of a snail in kilometers per second	1.3 x 10 ⁻⁵	.000013
Thickness of a sheet of paper in inches	2.75 x 10 ⁻³	.00275

5.5 Thinking About Polynomials

Expression	CHOOSE:	Degree
$3x^2 - 2x + 1$	Trinomial	2 nd
5xyz	Monomial	3rd
4x + 2y	Binomial	1 st
5x ² y - 11	Binomial	3rd
139	Monomial	0 degree
-642x ³⁹	Monomial	39 th
2y + 3x - 5w + p	Polynomial	1 st
$57x^5 - 2x^3 + 11x$	Trinomial	5 th
х	Monomial	1 st
$4x^2 + 3x + x$	Trinomial	2 nd
$2x + y + z^{12}$	Trinomial	12 th
5x ⁰	Monomial	0 degree
100x ² - py ³	Binomial	4 th
3x + 2	Binomial	1 st
10x - y + z + p - 5	Polynomial	1 st

5.5 Thinking About Polynomials (cont.)

answers will vary, ex. x² + 3x - 5
 answers will vary, ex. 5x⁴
 answers will vary, ex. 5x³ - 3x
 Yes, (x + 3) + (y + 5) = x + y + 8
 Yes, (x + 3) + (x - 3) = 2x
 Yes, (x + 3) + (x + 5) = 2x + 8
 Yes, (x + 3)(x - 3) = x² - 9
 Yes, (x + 3)(x + 2) = x² + 5x + 6
 Yes, (x + 3)(y + w) = xy + xw + 3y + 3w

5.6 Evaluating, Adding, and Subtracting Poly.

- 1a. f(2) = 3(4) 2(2) + 1 = 91b. g(-3) = -2(9) - 5 = -231c. h(0) = -4(0) + 2 = 21d. f(-5) = 3(25) - 2(-5) + 1 = 861e. g(0) = -2(0) - 5 = -51f. h(-5) = -4(-5) + 2 = 22
- 2a. $x^2 2x 4$ 2b. $-2x^2 - 4x - 3$ 2c. $3x^2 - 6x + 3$ 2d. $5x^2 - 2x + 6$ 2e. $-2x^2 + 4x - 7$ 2f. $3x^2 + 2x - 1$
- **3a.** $12x^2 8x + 4 6x^2 15$ = $6x^2 - 8x - 11$ **3b.** $15x^2 - 10x + 5 + 8x - 4$ = $15x^2 - 2x + 1$

5.7 Career Applications: STEM

- 1a. $R(x) C(x) = x^3 x^2 (.75x^3 .7x^2 .5x + 10)$ = $x^3 - x^2 - .75x^3 + .7x^2 + .5x - 10$ = $.25x^3 - .3x^2 + .5x - 10$ 1b. $R(3) = 3^3 - 3^2 = 27 - 9 = 18
- $C(3) = .75(3^3) .7(3^2) .5(3) + 10$ = .75(27) - .7(9) - 1.5 + 10 = 20.25 - 6.3 - 1.5 + 10 = **\$22.45** P(3) = 18 - 22.45 = -**\$4.45 (loss)**
- **1c.** $\mathbf{R}(20) = 20^3 20^2 = 8000 400 = 7600 $\mathbf{C}(20) = .75(20^3) - .7(20^2) - .5(20) + 10$ = .75(8000) - .7(400) - 10 + 10 = 6000 - 280 = \$5720 $\mathbf{P}(20) = 7600 - 5720 = 1880

Module 5: Integer Exponents and Laws, Scientific Notation, Polynomials and Operations

5.7 Career Applications: STEM (cont.)

1d. P(x) = 2R(x) - C(x) $= 2x^3 - 2x^2 - (.75x^3 - .7x^2 - .5x + 10)$ $= 1.25x^3 - 1.3x^2 + .5x - 10$ **2a.** P = x + x + x + x = 4x in. $A = x * x = x^2$ sq. in. **2b.** $\mathbf{P} = \mathbf{x} + (2\mathbf{x} + 1) + \mathbf{x} + (2\mathbf{x} + 1)$ = 6x + 2 ft.A = x(2x + 1) $= 2x^{2} + x sq. ft.$ **2c.** $\mathbf{P} = 3x + (x - 5) + 3x + x - 5$ = 8x - 10 cm A = 3x(x - 5) $= 3x^2 - 15x$ sq. cm **2d.** $\mathbf{P} = (x+5) + (x-3) + (x+5) + (x-3)$ = **4x** + **4 meters** A = (x + 5)(x - 3) $= x^2 - 3x + 5x - 15$ $= x^{2} + 2x - 15$ sq. meters **2e.** $\mathbf{P} = (x + 7) + (x - 7) + (x + 7) + (x - 7)$ = 4x miles A = (x + 7)(x - 7) $= x^{2} - 49$ sq. miles **2f.** $\mathbf{P} = (x + 5) + (x + 5) + (x + 5) + (x + 5)$ = 4x + 20 kmA = (x + 5)(x + 5) $= x^{2} + 10x + 25$ sq. km

3a. h(0) = -16(0)² + 177 = 177 This tells us that the penny is 177 feet off the ground (on top of the building) when you haven't thrown it yet
3b. h(1) = -16(1)² + 177 = -16 + 177 = 161 feet.

3c. $h(2) = -16(2)^2 + 177 = -64 + 177 = 113$ feet

3d. $h(3) = -16(3)^2 + 177 = 33$ feet

3e. No; h(4) = -16(4)² + 177 = -79 feet (underground?)!



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Adult Learning Academy Elementary Algebra Workbook



MODULE 6: FACTORING POLYNOMIALS, SOLVING QUADRATIC EQUATIONS BY FACTORING

LEARNING OBJECTIVES

By the time you finish this module, you should be able to:

□ Factor polynomials, choosing from a variety of strategies:

- o Greatest Common Factor
- o Reverse Foil
- Difference of Two Squares

- Factoring by Grouping
- o Difference of Cubes
- o Sum of Cubes

- □ Recognize Prime polynomials
- □ Solve quadratic equations by factoring
- □ Create quadratic equations to model situations and solve application problems

IMPORTANT INFORMATION FROM MODULE 6:

$$a^2 - b^2 = (a - b)(a + b)$$

 $a^2 + b^2$ is prime

 $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$

 $a^3 \cdot b^3 = (a - b)(a^2 + ab + b^2)$

ALWAYS check for COMMON FACTORS! If a polynomial doesn't factor, then it's prime. Always check inside parentheses to be sure you have factored completely. Check your factoring by multiplying your factors back to get the original polynomial.

A quadratic equation contains an x2. It has up to two solutions. The solutions are also the x-intercepts of the parabola if you graph the equation. To solve a quadratic equation by factoring:

- -- Get 0 on one side of the equation
- -- Factor the other side
- -- Set each factor = to 0

-- Solve



Adult Learning Academy Elementary Algebra Workbook MODULE 6 VIDEO & EXERCISE LIST



Торіс	Website	Videos	Exercises
Factoring with the	www.khanacademy.org	Factoring/distributive property 1	(refer to workbook)
distributive property		Factoring/distributive property 2	
		Factoring/distributive property 3	
		Factoring by grouping	
Factoring Quadratic	www.khanacademy.org	Factoring a Quadratic Expression	Factoring Quadratic Expressions
Expressions		Factoring a Quadratic Expression 2	More factoring trinomials
	youtube.com	Recognizing a Prime trinomial	
Factoring Special	www.khanacademy.org	Factoring Difference of Squares	Factoring Difference of Squares
Products		Factoring Difference of Squares 2	More Factoring Diff. of Squares
		Factoring Perfect Square Trinomials	Factoring Perfect Square Trinomials
	youtube.com	Factoring Rap	
Factoring trinomials in	youtube.com	Factoring by trial and error	Factoring by grouping
the form $ax^2 + by + c$	www.khanacademy.org	Factoring by grouping (3 videos)	
	youtube.com	Factoring Completely	
Factoring Cubes	Khanacademy.org	Difference of Cubes	Refer to workbook
		Sum of Cubes	
		Difference and Sum of Cubes	
Quadratic Equations	youtube.com	Zero Property Rule	Solving quadratic equations by factoring
	Khanacademy.org	Solving Quadratic Equations by factoring	
Module 6 Test Review	stlcc.edu	Blackboard PowerPoint	





1.	Find the	GCF from the li	st of terms.			
	a. 30, 75	5, 135		d. 1	$2x^3$, $6x^4$, $3x^5$	
	b. x ³ , x ²	² , x ⁵		e. p	$p^{7}q, p^{8}q^{2}, p^{9}q^{3}$	
	c. 32x ⁵	, 18x ²		f. x	x ³ , y ³ , z ³	
2.	Factor ou	it the GCF from	each polynomial. The fir	rst one is	done for you.	
	a. 3a + 6	б	<u>3(a + 2)</u>	e.	$6x^3 - 9x^2 + 12x$	
	b. 12x +	- 4		f.	4x - 8y + 4	
	c. 42y –	- 7		g.	$^{2}y^{2} + xy^{3} + x^{3}y$	
	d. 15a ³ -	+ 5a		h.	$99q^{7} + 24q$	
	i. a ⁷ b ⁶ -	$+ a^{3}b^{2} - a^{2}b^{5} - a^{2}$	b ²			
3.	. Since $5 \cdot 4 = 20$, the numbers 5 and 4 are called of 20.					
4.	List all the factors of $9xy^2$ (hint: there are 14 factors)					

5. List all the factors of $7y^3$



Adult Learning Academy Elementary Algebra Workbook 6.2 FACTORING BY GROUPING



To factor by grouping:

- 1. Group the terms in two groups so that each group has a common factor.
- 2. Factor out the GCF from each group.
- 3. If there is a common binomial factor, factor it out.
- 4. If not, rearrange the terms and try again.

Example: Factor xy + 2x + 3y + 6

- 1. Group terms: (xy + 2x) + (3y + 6)
- 2. Factor out the GCF: x(y+2) + 3(y+2)
- 3. Factor out the binomial: (y + 2) (x + 3)

Factor by grouping:

- 1. $x^3 + 2x^2 + 5x + 10$ 5. $5m^3 + 6mn + 5m^2 + 6n$
- 2. $x^3 + 4x^2 + 3x + 12$ 6. 2y - 8 + xy - 4y
- 3. 5x + 15 + xy + 3y7. xy + 3x + 3y + 9



Adult Learning Academy Elementary Algebra Workbook 6.3 FACTORING TRINOMIALS IN THE FORM OF X² + BX + C



- 1. Factor each trinomial. If the trinomial cannot be factored, write prime. Check your answer by using foil.
 - a. $x^2 + 7x + 12$ b. $y^2 + 11y + 18$ c. $a^2 + 5a 24$ d. $n^2 6n + 5$ e. $w^2 5w 50$ f. $a^2 + 3a + 11$ g. $b^2 + 17b + 66$ h. $x^2 x 10$ i. $x^2 + 5xy + 6y^2$ i. $x^4 + 5x^2 + 6$ k. k. $40 13t + t^2$ l. $-24 + 5a + a^2$
- Write a trinomial that is not prime: ______
 Write a trinomial that is prime: ______
- 4. Find all positive values of b so that the trinomial is factorable: $y^2 + by + 20$
- 5. Factor each trinomial completely. Factor out the GCF first.
 - a. $2z^2 + 20z + 32$ b. $3x^2 + 30x 63$
 - c. $4x^2 4x 48$ d. $x^3 + 11x^2 + 30x$
- 6. Write a trinomial that must have its GCF factored out before you can factor.



Adult Learning Academy Elementary Algebra Workbook 6.4 PERFECT SQUARE TRINOMIALS AND DIFFERENCE OF SQUARES



A perfect square trinomial is a trinomial that is the square of a binomial.

For example:
$$(x+5)^2 = (x+5)(x+5) = x^2 + 10x + 25$$

The following formulas can be used when factoring perfect square trinomials:

 $a^{2} + 2ab + b^{2} = (a + b)^{2}$ and $a^{2} - 2ab + b^{2} = (a - b)^{2}$

1. Factor the following perfect square trinomials. Write your answer with an exponent.

a.
$$x^2 + 20x + 100$$
 b. $a^2 + 2a + 1$

- c. $w^2 16w + 64$ d. $n^2 6n + 9$
- e. $x^2 + 2xy + y^2$ f. $9x^2 + 3x + \frac{1}{4}$

The **difference of two squares** is another type of special product. Consider the difference between these two perfect squares: $w^2 - 49 = (w+7)(w-7)$ Notice when foil is used to multiply the two binomials, the middle term cancels out.

The following formula can be used to factor the difference of squares:

$$a^2 - b^2 = (a+b)(a-b)$$

- 2. Factor the following difference of squares.
 - a. $w^2 81$ b. $16a^2 - 1$ c. $b^2 - \frac{9}{25}$ d. $c^4 - d^6$ e. $121x^2 - \frac{1}{4}$ f. $x^4y^2 - z^8$



Adult Learning Academy Elementary Algebra Workbook 6.5 FACTORING TRINOMIALS IN THE FORM OF AX² + BY + C



Before attempting to factor these trinomials, make sure you have watched the video on **trial** and error and the video on grouping to factor trinomials in the form of $ax^2 + by + c$. Use whichever method works best for the trinomial. None of these trinomials are prime; they can all be factored.

1. $2x^2 + 8x + 6$ 2. $3x^2 + 8x + 5$

3. $5w^2 + 7w + 2$ 4. $7a^2 + 19a - 6$

5. $11n^2 + 12xy + y^2$ 6. $5a^2 - 6ab + b^2$

- 7. $4x^2 4x + 1$ (no need for trial/error or grouping) 8. $6x^2 + 6x - 12$
- 9. $10x^2 + 40x + 40$ 10. $3x^2 5xy 2y^2$



Adult Learning Academy Elementary Algebra Workbook 6.6 SUM AND DIFFERENCE OF CUBES



Although the sum of two squares cannot usually be factored, the sum of two cubes and the difference of two cubes can be factored using the following formulas:

Sum: $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$

Difference: $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$

- 1. Factor the following sum of cubes and difference of cubes.
 - a. $x^3 + 8$ b. $y^3 + 1$

c.
$$w^3 - 27$$
 d. $8a^3 + 125$

e.
$$z^3 - 64$$
 f. $a^6 + b^3$

2. For the following problems, factor out a common factor and then factor the sum or difference of cubes.

a.
$$125q^2 - n^3q^2$$
 b. $4w^3 + 4$

c. $3x^6y^2 + 81y^2$ d. $ax^3 - ay^3$



Adult Learning Academy Elementary Algebra Workbook 6.7 SOLVING QUADRATIC EQUATIONS



Solve the following quadratic equations. Make sure you watch the video on the **zero product property** and practice solving quadratic equations on Khan Academy before trying these problems.

1. $x^2 + 5x + 6 = 0$ 2. $y^2 + 10 = -24$

3.
$$a^2 - 49 = 0$$

4. $16x^2 + 40x + 25 = 0$

5. $x^2 = 6x - 9$ 6. $2a^2 - 9a = -7$

7. $4b^2 - 100 = 0$ 8. $a^2 - 6a = 16$

9. $x^2 - 18 = -7x$ 10. $a^2 = 49$





- 1. Factor Completely.
 - a. $12a^2 + 20a$ b. $x^2 4x + 2xy 8y$
 - c. $x^2 + 17x + 30$ d. $x^2 x 30$
 - e. $x^2 14x + 30$ f. $x^2 25$
 - g. $x^2 + 49$ h. $3y^2 27$
 - i. $2x^2 + 14x + 20$ j. $x^2 8x + 16$
 - k. 7x + 13x + 5l. $3x^3 + 9x^2 - 12x$
 - m. $x^3 125$ n. $27x^3 + 1$
- 2. Solve the following equations.
 - a. $x^2 24x 81 = 0$ b. $2y^2 + 16x + 30 = 0$
 - c. $x^2 = 100$ d. $x^2 + 14x = -24$



Adult Learning Academy Elementary Algebra Workbook 6.9 CAREER APPLICATIONS: STEM



1. Find the perimeter of the rectangle and write as a simplified trinomial. Then factor the trinomial completely.

 $L=x^{\mathbf{2}}+2x$

2. Find the perimeter of the triangle and write as a simplified trinomial. Then factor the trinomial completely.



- 3. The area of a rectangle is $x^2 + 9x + 20$.
 - a. Find the length and width in terms of x. (hint: factor the trinomial)
 - b. The perimeter of the rectangle is 30 inches. Find the actual dimensions of the rectangle. (hint: solve for x)
 - c. Find the actual area of the rectangle.

- 4. The area of a square is 81 units squared. Find the length of a side. s =_____
- 5. The area of a square is $x^2 + 6x + 9$.
 - a. Find the length of a side in terms of x.
 - b. Find the actual length of a side if the perimeter is 52 units.
 - c. Find the actual length of a side if the perimeter is 24 units.
 - d. Find the actual **area** of the square if the perimeter is 36 units.
 - e. The trinomial $x^2 + 6x + 9$ is a ______ trinomial.
- 6. An object is dropped from a building that is 841 feet tall. The height of the object after t seconds is $841 16t^2$.
 - a. Find the height of the object after 2 seconds.
 - b. Find the height of the object after 5 seconds.
 - c. To the nearest whole second, estimate when the object hits the ground.
 - d. Factor 841 16t².
- 7. An object is dropped from the top of the Woolworth building in New York City. The height h of the object after t seconds is given by the equation $h = -16t^2 + 784$.

Find how many seconds pass before the object reaches the ground.

8. The area of a rectangle is 54 square units. Find the dimensions of the rectangle.

$$W = x - 1$$

L = x + 2

9. Find the lengths of the sides of a right triangle is the hypotenuse is 10 centimeters longer than the shorter leg and 5 centimeters longer than the longer leg. (show all of your work)

10. If the cost, C, for manufacturing x units of a certain product is given by $C = x^2 - 15x + 50$, find the number of units manufactured at a cost of \$9500.

- 11. Write a quadratic equation in standard form that has two solutions, 6 and -1.
- 12. Write a quadratic equation in standard form that has two solutions, 7 and 5.



Adult Learning Academy Elementary Algebra Workbook MODULE 6 ANSWER KEY



6.1 GCF and Factoring with Distributive Propert	<u>y</u> <u>6.3 Trinomials in the form of $x^2 + bx + c$</u>
1a. 15	1a. $(x + 3)(x + 4)$
1b. x ²	1b. $(y + 9)(y + 2)$
1c. 2x ³	1c. $(a - 3)(a + 8)$
1d. $3x^3$	1d. $(n-5)(n-1)$
1e. p ⁷ q	1e. $(w - 10)(w + 5)$
1f. <mark>1</mark>	1f. Prime
	1g. $(b + 6)(b + 11)$
2b. $4(3x + 1)$	1h. Prime
2c. 7(6y – 1)	1i. $(x + 3y)(x + 2y)$
2d. $5a(3a^2 + 1)$	1j. $(x^2 + 3)(x^2 + 2)$
2e. $3x(2x^2 - 3x + 4)$	1k. $(t-8)(t-5)$
2f. $4(x - 2y + 1)$	11. $(a+8)(a-3)$
2g. $xy(xy + y^2 + x^2)$	
2h. $3q(33q^6 + 8)$	2. Answers will vary; ex. $x^2 + 7x + 10$
2i. $a^{2}b^{2}(a^{5}b^{4} + a - b^{3} - 1)$	3. Answers will vary; ex. $x^2 + 157x + 10$
	4. 9, 12, 21

5a. $2(z^2 + 10z + 16) = 2(z + 8)(z + 2)$ 5b. $3(x^2 + 10x + 21) = 3(x + 7)(x + 3)$ 5c. $4(x^2 - x - 12) = 4(x - 4)(x + 3)$ 5d. $x(x^2 + 11x + 30) = x(x + 6)(x + 5)$

6. Answers will vary; ex. 100x² + 700x + 1000

6.4 Perfect Sq. Trinomials and Difference of Squares

1a. $(x + 10)(x + 10) = (x + 10)^2$ 1b. $(a + 1)(a + 1) = (a + 1)^2$ 1c. $(w - 8)(w - 8) = (w - 8)^2$ 1d. $(n - 3)(n - 3) = (n - 3)^2$ 1e. $(x + y)(x + y) = (x + y)^2$ 1f. $(3x + \frac{1}{2})(3x + \frac{1}{2}) = (3x + \frac{1}{2})^2$

2a. (w - 9)(w + 9)2b. (4a - 1)(4a + 1)2c. (b + 3/5)(b - 3/5)2d. $(c^2 - d^3)(c^2 + d^3)$ 2e. $(11x - \frac{1}{2})(11x + \frac{1}{2})$ 2f. $(x^2y - z^4)(x^2y + z^4)$

6.2 Factoring by Grouping

5. 1, 7, y, 7y, y^2 , $7y^2$, y^3 , $7y^3$

4. 1, 3, 9, x, 3x, 9x, y, 3y, 9y, y², 3y², 9y², xy², 3xy², 9xy²

3. factors

1. $x^{2}(x+2) + 5(x+2)$ $=(x+2)(x^2+5)$ 2. $x^{2}(x+4) + 3(x+4)$ $= (x + 4)(x^2 + 3)$ 3. 5(x+3) + y(x+3)= (x + 3)(5 + y)4. $2x^{2}(3x-2) + 5(3x-2)$ $=(3x-2)(2x^2+5)$ 5. $m(5m^2 + 6n) + 1(5m^2 + 6n)$ $=(5m^2+6n)(m+1)$ 6. 2(x-4) + y(x-4)= (x - 4)(2 + y)7. x(y+3) + 3(y+3)= (y + 3)(x + 3)8. a(b-5) + 6(b-5)= (b - 5)(a + b)

<u>6.5 Factoring Trinomials in the Form of ax^2 + by + c</u>

- 1. $2(x^2 + 4x + 3)$ = 2(x + 3)(x + 1)
- 2. (3x+5)(x+1)
- 3. (5w + 2)(w + 1)
- 4. (7a 2)(a + 3)
- 5. (11n + y)(n + y)
- 6. (5a b)(a b)
- 7. (2x 1)(2x 1)= $(2x - 1)^2$
- 8. $6(x^2 + x 2)$ = 6(x + 2)(x - 1)
- 9. $10(x^2 + 4x + 4)$ = 10(x + 2)(x + 2)= $10(x + 2)^2$
- 10. (3x + y)(x 2y)

6.6 Sum and Difference of Cubes

1a. $x^3 + 2^3$ = $(x + 2)(x^2 - 4x + 4)$ 1b. $y^3 + 1^3$ = $(y + 1)(y^2 - y + 1)$ 1c. $w^3 - 3^3$ = $(w - 3)(w^2 + 3w + 9)$ 1d. $(2a)^3 + 5^3$ = $(2a + 5)(4a^2 - 10a + 25)$ 1e. $z^3 - 4^3$ = $(z - 4)(z^2 - 4z + 16)$ 1f. $(a^2)^3 + b^3$ = $(a^2 + b)(a^4 - a^2b + b^2)$

2a.
$$q^2(125 - n^3)$$

 $= q^2(5^3 - n^3)$
 $= q^2(5 - n)(25 + 5n + n^2)$
2b. $4(w^3 + 1)$
 $= 4(w^3 + 1^3)$
 $4(w + 1)(w^2 - w + 1)$
2c. $3y^2(x^6 + 27)$
 $= 3y^2[(x^2)^3 + 3^3]$
 $= 3y^2(x^2 + 3)(x^4 - 3x^2 + 9)$
2d. $a(x^3 - y^3)$
 $= a(x - y)(x^2 + xy + y^2)$

6.7 Solving Quadratic Equations

- **1.** (x + 3)(x + 2) = 0 x + 3 = 0 or x + 2 = 0x = -3 or x = -2
- 2. $y^2 + 10y + 24 = 0$ (y + 6)(y + 4) = 0 y + 6 = 0 or y + 4 = 0 y = -6 or y = -4
- **3.** (a 7)(a + 7) = 0 a - 7 = 0 or a + 7 = 0 **a = 7 or a = -7**
- 4. (4x + 5)(4x + 5) = 0 4x + 5 = 0 or 4x + 5 = 0x = -5/4
- 5. $x^2 6x + 9 = 0$ (x - 3)(x - 3) = 0 x - 3 = 0 x = 3
- 6. $2a^2 9a + 7 = 0$ (2a - 7)(a - 1) = 0 2a - 7 = 0 or a - 1 = 0a = 7/2 or a = 1
- 7. $4(b^2 25) = 0$ 4(b - 5)(b + 5) = 0 b - 5 = 0 or b + 5 = 0b = 5 or b = -5
- 8. $a^2 6a 16 = 0$ (a - 8)(a + 2) = 0 a - 8 = 0 or a + 2 = 0a = 8 or a = -2
- 9. $x^2 + 7x 18 = 0$ (x + 9)(x - 2) = 0 x + 9 = 0 or x - 2 = 0x = -9 or x = 2
- **10.** $a^2 49 = 0$ (a - 7)(a + 7) = 0a - 7 = 0 or a + 7 = 0a = 7 or a = -7

6.8 Factoring Review

1a. 4a(3a + 5)1b. x(x-4) + 2y(x-4) = (x+2y)(x-4)1c. (x + 15)(x + 2)1d. (x - 6)(x + 5)1e. Prime 1f. (x + 5)(x - 5)1g. Prime

6.8 Factoring Review (cont.) 1h. $3(y^2 - 9)$ = 3(y-3)(y+3)**1h.** $3(v^2 - 9)$ = 3(y-3)(y+3)1i. $2(x^2 + 7x + 10)$ = 2(x + 5)(x + 2)**1i.** (x - 4)(x - 4) $=(x-4)^{2}$ 1j. Prime 1k. $3x(x^2 + 3 - 4)$ = 3x(x+4)(x-1)**1k.** a = x, b = 5 $= (x-5)(x^2 + 5x + 25)$ **1k.** a = 3x, b = 1 $=(3x+1)(9x^2-3x+1)$ **2a.** (x - 27)(x + 3) = 0x - 27 = 0 or x + 3 = 0x = 27 or x = -3**2b.** $2(y^2 + 8x + 15) = 0$ 2(y+5)(y+3) = 0y + 5 = 0 or y + 3 = 0y = -5 or y = -32c. x = 10 or x = -10**2d.** $x^2 + 14x + 24 = 0$ (x + 12)(x + 2) = 0

6.9 Career Applications: STEM

x + 12 = 0 or x + 2 = 0

y = -12 or y = -2

1. To find perimeter, add all sides: $x^{2} + 2x + x^{2} + 2x + 5x + 10 + 5x + 10$ $= 2x^{2} + 14x + 20$ $= 2(x^2 + 7x + 10)$ = 2(x + 5)(x + 2)**2.** $x^2 + 8 + x^2 - 9x + x^2 - 20$ $=3x^2-9x-12$ $=3(x^2-3x-4)$ = 3(x-4)(x+1)3a. (x+5)(x+4)**3b.** x + 5 + x + 5 + x + 4 + x + 4 = 304x + 18 = 304x = 12 $\mathbf{x} = \mathbf{3}$ length = 3 + 5 = 8 in. width = 3 + 4 = 7 in. **3c.** To find area, multiply length by width: $8 \times 7 = 56$ in. 6.9 Career Applications: STEM (cont.)

4. $s^2 = 81$ $s = \sqrt{81}$ s = 9 5a. x + 3**5b.** 4(x + 3) = 524x + 12 = 524x = 40x = 105c. 4(x + 3) = 244x + 12 = 244x = 12 $\mathbf{x} = \mathbf{3}$ **5d.** area = $36 = 6^2$ so each side is 6 6+6+6+6=245e. perfect square 6a. t = 2h = 841 - 16(4) = 841 - 64**h** = 777 feet high **6b.** t = 5h = 841 - 16(25) = 841 - 400**h** = 441 feet high **6c.** h = 0 (height of ground) To estimate, try different values of t. If t = 7, h = 841 - 16(49) = 841 - 784 = 57 $\mathbf{t} = \mathbf{7}$ is the closest you can get to the ground in whole numbers of seconds To solve exactly $0 = 841 - 16t^2$ $0 = 29^2 - 16t^2$ 0 = (29 + 4t)(29 - 4t)29 + 4t = 0 or 29 - 4t = 0t = 29/4 or t = -29/4t = 7.25 (negative time does not make sense) 6d. (29 - 4t)(29 + 4t)7. $0 = -16t^2 + 784$

7. $0 = -16t^{2} + 784$ $0 = -16(t^{2} - 49)$ 0 = -16(t - 7)(t + 7) t - 7 = 0 or t + 7 = 0t = 7 seconds (-7 does not make sense)

6.9 Career Applications: STEM (cont.)

8. (x-1)(x+1) = 54 $x^2 + x - 2 = 54$ $x^2 + x - 56 = 0$ (x+8)(x-7) = 0x + 8 = 0 or x - 7 = 0 $\mathbf{x} = \mathbf{7}$ (-8 does not make sense) length = 7 + 2 = 9width = 7 - 1 = 6**9.** Pythagorean Theorem: $a^2 + b^2 = c^2$ let x = shorter leg, hypotenuse = x + 10, longer leg = x+5 $x^{2} + (x + 5)^{2} = (x + 10)^{2}$ $x^2 + x^2 + 10x + 25 = x^2 + 20x + 100$ $x^2 - 10x - 75 = 0$ (x-15)(x+5) = 0x - 15 = 0 or x + 5 = 0x = 15 or x = -5**10.** $9500 = x^2 - 15x + 50$ $x^2 - 15x - 9450 = 0$ (x + 90)(x - 105) = 0x + 90 = 0 or x - 105 = 0 $\mathbf{x} = \mathbf{105}$ (-90 does not make sense) **11.** (x-6)(x+1) = 0 $x^2 - 5x - 6 = 0$ 12. (x-7)(x-5) = 0 $x^2 - 12x + 35 = 0$



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