Adult Learning Academy<br>Elementary Algebra Workbook

Module 1: Expressions, Equations, and Inequalities Learning Objectives
By the time you finish this module, you should be able to:
$\square$ Review topic: Add, subtract, multiply, and divide fractions and integers (neg, pos)
$\square$ Write and simplify algebraic expressions using variables
$\square$ 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 sidesSolve 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 $\quad$ Neg + Neg $=$ NEG (watch this one! $\quad$ Pos + Neg $=$ it depends!
To subtract a number, ADD its OPPOSITE
Pos x Pos $=$ Pos $\quad$ Neg x Neg $=$ Pos $\quad$ Pos x Neg $=$ Neg $\quad$ Neg x Pos $=$ Neg
Pos $\div$ Pos $=$ pos $\quad \mathrm{Neg} \div \mathrm{Neg}=\mathrm{Pos} \quad \mathrm{Pos} \div \mathrm{Neg}=\mathrm{Neg} \quad \mathrm{Neg} \div$ Pos $=\mathrm{Neg}$
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.

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## Module 1 Video \& Exercise List

| Topic | Website | Videos | Exercises |
| :---: | :---: | :---: | :---: |
| Review Fractions, Integers | www.stlcc.edu | Blackboard Review Flashcards: Fractions |  |
|  |  | Blackboard Review Flashcards: Integers |  |
| If you need more review of | ions and integers, see the | w 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 |  |
|  |  |  |  |
|  |  |  |  |


| Topic | 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 | ch?v=KBpNLjiv8pk |  |
| Combining like terms | http://www.youtube.com/ | ch?v=fXD4DjSyoyo |  |
| Variable on each side | http://www.youtube.com/ | ch? $\mathrm{v}=\mathrm{gQdH5} 5 \mathrm{KWrPQ}$ |  |
| Distributive Property | http://www.youtube.com/ | ch?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/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 $1 / 2$ :
2. Write a fraction that is equal to 1 :
3. Write a fraction that is greater than 1 :
4. Write a fraction that is less than $\frac{1}{5}$ :
5. Write a fraction that is equal to 0 :
6. What is half of $\frac{2}{3}$ ?
7. Write a fraction that is UNDEFINED:

Simplify:
8. $\frac{4}{10}+\frac{3}{10}$
9. $\frac{3}{10}+\frac{2}{15}$
10. $\frac{4}{5} \cdot \frac{15}{9}$
11. $\frac{4}{5} \div \frac{8}{15}$
12. $3 \frac{7}{9}-1 \frac{1}{6}$
13. $5 \frac{1}{2} \cdot 2 \frac{4}{5}$
14. $\left(\frac{3}{4}\right)^{2}$
15. $\frac{15}{3}+\frac{9}{16}\left(1 \frac{1}{3}\right)^{2}$

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### 1.2 Pre-Algebra Review: Fractions Video \& Exercise List

| Topic | Website | Videos | Exercises |
| :--- | :--- | :--- | :--- |
| Understanding Fractions | www.khanacademy.org | Numerator, Denominator of a Fraction | Recognizing Fractions 0.5 |
|  |  |  | Recognizing Fractions |
|  |  |  | Fractions on the Number line 1 |
| Equivalent Fractions | www.khanacademy.org | Equivalent Fractions | Fraction Word Problems 1 |
|  |  | Equivalent Fractions Example | Simplifying Fractions |
|  |  | Comparing Fractions | Comparing Fractions 1 |
|  |  | Fractions in Lowest Terms | Equivalent Fractions |
|  |  | Ordering Fractions | Equivalent Fractions 2 |
| Comparing Fractions 2 | 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 |  |
| Multiplying Fractions | Adding Fractions Ex. 1 | Adding and Subtracting Fractions |  |
|  | www.khanacademy.org | Multiplying Fractions | Multiplying Fractions 0.5 |
| Dividing Fractions | Multiplying Fractions Word Problem | Multip. Fractions Word Problems |  |
|  | www.khanacademy.org | Dividing Fractions | Dividing Fractions 0.5 |
|  | Dividing Fractions Example | Dividing Fractions Word Problems |  |
|  |  | Dividing Fractions Word Problems |  |
|  |  |  |  |


| Topic | 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. |  |  |
| 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 |  |  |
| Mixed Number Mult \& Div |  | Subtracting Mixed Numbers 2 |  |
|  | Subtracting Mixed Numbers Word Prob |  |  |
|  | Multiplying Fractions and Mixed Nos. | Multiplying Mixed Numbers 1 |  |
|  |  | Multiplying Mixed Numbers |  |
|  |  | Dividing Mixed Numbers |  |

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### 1.3 Pre-Algebra Review: Do You Remember Integers?

SIMPLIFY:

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

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### 1.4 Pre-Algebra Review: Integers Video \& Exercise List

| Topic | Website | Videos | Exercises |
| :---: | :---: | :---: | :---: |
| Negative Number Basics | www.khanacademy.org | Negative Numbers Introduction | Number Line 2 |
|  |  | Ordering Negative Numbers | Ordering Negative Numbers |
|  |  |  | Number Line 3 |
| Adding Integers | www.khanacademy.org | Example: Adding Negative Numbers | 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 |  |
| Multiplying/Dividing Neg \# | www.khanacademy.org | Multiplying Pos and Neg Numbers | Mult/Div Negative Numbers |
|  |  | Why Neg x Neg is positive | Negative Number Word Probs |
|  |  | Dividing Pos and Neg Numbers |  |
|  |  | Example: Mult \#'s w/ diff signs |  |
|  |  | Mult and Div Negative 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 | $\frac{3}{6}-\frac{4}{8}$ | $6 \div 0$ | $\frac{2}{1}$ |
| :---: | :---: | :---: | :---: | :---: |
| (-5)(4) | $\frac{3}{6}+\frac{5}{10}$ | Half of $1 / 2$ | $-3^{2}$ | 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 | $-5+3$ |
| $\frac{15}{37} \cdot \frac{37}{15}$ | $-6 \div 3$ | $10^{2}$ | $-11+2$ | $\|3-5\|$ |
| $5 \frac{1}{4}$ | $9 \div(3-3)$ | (-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 |

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1.6 SIMPLIFYING Expressions

1. $5 x+3 x$
2. $5(\mathrm{x}-2)$
3. $5 x-3 x$
4. $3(x+1)$
5. $3 x-5 x$
6. $5(\mathrm{x}-1)+3(\mathrm{x}+2)$
7. $\mathrm{x}+\mathrm{x}$
8. $3 x+5-(2 x+1)$
9. $\mathrm{x}-\mathrm{x}$
10. $3 x+5-(2 x-1)$
11. $\mathrm{x} \cdot \mathrm{x}$
12. $3 x+5(2 x-1)$
13. $\mathrm{x} \div \mathrm{x}$
14. $3 x-5(2 x-1)$
15. $x+y$
16. $7-3(2 \mathrm{x}-1)$
17. $3 x+3 y+5 x-y$
18. $7-3(2 \mathrm{x}+1)$

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1.7 Solving 1-Step Equations

1. $\mathrm{x}+3=15$
2. $x-4=20$
3. $6 \mathrm{y}=48$
4. $\frac{a}{3}=12$
5. $\mathrm{w}+100=-300$
6. $\mathrm{x}-12=-20$
7. $-6 y=48$
8. $\frac{a}{3}=-9$
9. $-5=x+4$
10. $5 \mathrm{x}=7$
11. $1 / 2 \mathrm{x}=12$
12. $3 / 4 \mathrm{x}=18$
13. $7 \mathrm{x}=7$
14. $\mathrm{x}-\frac{1}{2}=\frac{3}{2}$
15. $-\mathrm{x}=-7$
16. $5 x=0$

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1.8 Solving 2-STEP Equations

1. $2 \mathrm{x}+1=7$
2. $3 x-1=11$
3. $-2 \mathrm{x}+1=9$
4. $-5 x-1=9$
5. $5+3 x=17$
6. $7-3 x=13$
7. $7=5+2 x$
8. $10-3 x=13$
9. $\frac{x+4}{3}=10$
10. $\frac{x-7}{5}=2$
11. $-4 \mathrm{a}+2=2$
12. $\frac{w}{3}-10=0$

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1.9 Solving Multi-Step Equations

1. $x+3 x=12$
2. $5 x-3 x+2=12$
3. $5(x-2)=20$
4. $3(x+1)=15$
5. $-2(x+4)=16$
6. $-5 x+3=-4 x$
7. $x-5=2 x$
8. $3 \mathrm{x}=\mathrm{x}+4$
9. $4 \mathrm{x}=2 \mathrm{x}+10$
10. $2(\mathrm{x}+1)=\mathrm{x}-3$
11. $-2(x+1)=3 x-7$

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1.10 Expressions \& Equations

EXPRESSION (SIMPLIFY if possible)

1. $\mathrm{x}+\mathrm{x}+\mathrm{x}$
2. $3(x-4)$
3. $5 \mathrm{x}-\mathrm{x}$
4. $2-\mathrm{x}$
5. $\mathrm{x}-5-3$
6. $7-2(x+1)$
7. $7-2(x-1)$
8. $4 \mathrm{x}-1 / 2 \mathrm{x}$

## EQUATION (SOLVE)

9. $\mathrm{x}+\mathrm{x}+\mathrm{x}=12$
10. $3(x-4)=5$
11. $5 \mathrm{x}-\mathrm{x}=-20$
12. $2-\mathrm{x}=-6$
13. $x-5-3=80$
14. $7-2(x+1)=-1$
15. $7-2(x-1)=-1$
16. $4 \mathrm{x}-1 / 2 \mathrm{x}=7$

## Adult Learning Academy <br> Elementary Algebra Workbook <br> 1.11 Special Equations

$x+4=x$
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!
$3 x-5=3 x+1$
When we subtract $3 x$ 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!

$$
4 x+5=4 x+5
$$

If we subtract 4 x 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.
$3(x-6)=3 x-18$
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. $3 x+5=5$
2. $3 x+5=3 x+5$
3. $3 x+5=3 x+7$
4. $3(x+2)=3 x+6$
5. $3(x+2)=3 x+5$
6. $3(x+2)=2 x+5$
7. $\mathrm{x}=\mathrm{x}$
8. $x=x-1$
9. $4 \mathrm{x}+1=\mathrm{x}-2$
10. $x+x=2 x$
11. $x+x=3 x$
12. $\mathrm{x}+\mathrm{x}=6$
13. $\mathrm{x}+\mathrm{x}=\mathrm{x}+1$
14. $x+1=x+2$
15. $x+1=6$

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1.12 SOLVING INEQUALITIES

1. $\mathrm{x}+4>12$
a. Graph:

b. Set-builder $\{\mathrm{X} \mid$
c. Interval notation:
2. $\mathrm{x}+4>12$
a. Graph:

b. Set-builder $\{\mathrm{X} \mid$
\}
c. Interval notation:
3. $\mathrm{x}+4>12$
a. Graph:

b. Set-builder $\{\mathrm{X} \mid$
c. Interval notation:
4. $\mathrm{x}+4>12$
a. Graph:

b. Set-builder $\{\mathrm{X} \mid$
\}
c. Interval notation:
5. $\mathrm{x}+4>12$
a. Graph:

b. Set-builder $\{\mathrm{X} \mid$
\}
c. Interval notation:
6. $\mathbf{x}+4>12$
a. Graph:

b. Set-builder $\{\mathrm{X} \mid$
c. Interval notation:
7. $\mathbf{x}+4>12$
a. Graph:

b. Set-builder $\{\mathrm{X} \mid$
\}
c. Interval notation:
8. $\mathrm{x}+4>12$
a. Graph:

b. Set-builder $\{\mathrm{X} \mid \quad\}$
c. Interval notation:
9. $\mathrm{x}+4>12$
a. Graph:

b. Set-builder $\{\mathrm{X} \mid$
c. Interval notation:
10. $\mathrm{x}+4>12$
a. Graph:

b. Set-builder $\{\mathrm{X} \mid$
c. Interval notation:
11. $\mathrm{x}+4>12$
a. Graph:

b. Set-builder $\{\mathrm{X} \mid$
\}
c. Interval notation:
12. $\mathrm{x}+\mathbf{4}>12$
a. Graph:

b. Set-builder $\{\mathrm{X} \mid$
\}
c. Interval notation:

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1.13 Color Matching Inequalities

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

| +1, | $x>3$ | $(-\infty, 3)$ |
| :---: | :---: | :---: |
| $\longleftarrow$ ) | $x<-3$ | $[3, \infty)$ |
| $\longleftarrow$ | $x \geq 3$ | $(-\infty, 3]$ |
| +1, | $-3<x \leq 3$ | $(3, \infty)$ |
| $\longleftarrow)$ | $x \leq-3$ | $(-3,3)$ |
| $\xrightarrow{[+\ldots+3}$ | $-3<x<3$ | $[-3,3)$ |
| $\longleftarrow 1$ | $x \leq 3$ | $(-3,3]$ |
| ( | $-3 \leq x<3$ | $(-\infty,-3)$ |
|  | $x \geq-3$ | $[-3, \infty)$ |
| $(+1+2)$ | $x<3$ | $(-\infty,-3]$ |

## Adult Learning Academy <br> Elementary Algebra Workbook 1.12 CAREER APPLICATIONS: STEM

1. A laptop computer weighs 3 pounds.
a. How much would 2 computers weigh? $\qquad$
b. How much would 10 computers weigh? $\qquad$
c. How much would $x$ computers weigh? $\qquad$
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: $\qquad$
b. A plant with 4 fewer leaves than the experimental plant: $\qquad$
c. A plant with twice as many leaves as the experimental plant: $\qquad$
d. A plant with 3 more than 5 times as many leaves as the experimental plant: $\qquad$
e. A plant with 1 less than twice as many leaves as the experimental plant: $\qquad$
f. A plant with the same number of leaves as the experimental plant: $\qquad$
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? $\qquad$
b. The total saline used in both solutions: $\qquad$
c. If $\mathrm{X}>\mathrm{Y}$, how much more saline is in the first solution than the second? $\qquad$
d. The mean amount of saline in the two solutions: $\qquad$
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?
$\qquad$
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.

c. X miles
Perimeter: $\qquad$
Area: $\qquad$
Perimeter: $\qquad$
Area: $\qquad$ Area: $\qquad$
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.

### 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. $\frac{9}{30}+\frac{4}{30}=\frac{\mathbf{1 3}}{\mathbf{3 0}}$
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. $\frac{34}{9}-\frac{7}{6}=\frac{68}{18}-\frac{21}{18}=\frac{47}{18}=2 \frac{\mathbf{1 1}}{18}$
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. 10
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. $\frac{1}{2}$
1.5 Practice with Fractions \& Integers

| $\begin{aligned} & \frac{4}{5}+\frac{3}{10} \\ & =1 \frac{1}{10} \\ & \hline \end{aligned}$ | $\begin{gathered} -1-1 \\ =-2 \end{gathered}$ | $\begin{gathered} \frac{3}{6}-\frac{4}{8} \\ =0 \end{gathered}$ | $\begin{gathered} 6 \div 0 \\ \text { undefined } \end{gathered}$ | $\begin{gathered} \frac{2}{1} \\ =2 \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: |
| $\begin{gathered} (-5)(4) \\ =-20 \end{gathered}$ | $\frac{3}{6}+\frac{5}{10}$ | $\begin{aligned} & \text { Half of } 1 / 2 \\ & =1 / 4 \end{aligned}$ | $\begin{aligned} & -3^{2} \\ & =-9 \end{aligned}$ | $\begin{gathered} \text { Double } 10 . \\ =\mathbf{2 0} \end{gathered}$ |
| $\begin{gathered} -32+32 \\ =0 \end{gathered}$ | $\begin{gathered} (-10)^{2} \\ =100 \end{gathered}$ | $\frac{47}{0} \text { undefined }$ | $\begin{array}{r} \frac{33}{30} \\ 1 \frac{1}{10} \end{array}$ | Half of $\frac{5}{3}$ $=\frac{5}{6}$ |
| $\begin{gathered} 10-(-2) \\ =12 \end{gathered}$ | $\frac{-10}{2}$ $=-5$ | -50 <br> -25 <br> $=2$ | $\begin{gathered} -15-5 \\ =-20 \end{gathered}$ | $\begin{gathered} 7+(-6) \\ =\mathbf{1} \end{gathered}$ |
| $\begin{gathered} -2-7 \\ =-9 \end{gathered}$ | $\frac{7}{14} \div 2$ $=1 / 4$ | $\begin{gathered} \frac{1}{2}+\frac{1}{3} \\ =\frac{5}{6} \end{gathered}$ | $\begin{aligned} & \frac{0}{47} \\ & =0 \end{aligned}$ | $\begin{array}{r} \frac{45}{54} \\ =\frac{5}{6} \end{array}$ |
| $\begin{gathered} 15-(-5) \\ =\mathbf{2 0} \end{gathered}$ | $\begin{gathered} 5 \frac{1}{2} \div 5 \\ 1 \frac{1}{10} \end{gathered}$ | $\begin{aligned} & 3 \frac{1}{2} \cdot 1 \frac{1}{2} \\ & =5 \frac{1}{4} \\ & \hline \end{aligned}$ | $-4-1$ $=-5$ | $\begin{gathered} -5+3 \\ =-2 \end{gathered}$ |
| $\frac{15}{37} \cdot \frac{37}{15}$ | $\begin{gathered} -6 \div 3 \\ =-2 \end{gathered}$ | $\begin{gathered} 10^{2} \\ =100 \end{gathered}$ | $\begin{gathered} -11+2 \\ =-9 \end{gathered}$ | $\begin{gathered} \|3-5\| \\ =\mathbf{2} \end{gathered}$ |
| $5 \frac{1}{4}$ | $\begin{gathered} 9 \div(3- \\ 3) \\ \text { undefined } \\ \hline \end{gathered}$ | $\begin{gathered} (-3)(-4) \\ =12 \end{gathered}$ | $\begin{gathered} \frac{3}{2} \div \frac{2}{7} \\ =5 \frac{1}{4} \end{gathered}$ | $\begin{aligned} & 0-5 \\ & =-5 \end{aligned}$ |
| $\begin{gathered} \frac{5}{2} \cdot \frac{24}{5} \\ =12 \end{gathered}$ | $\begin{gathered} (-4)(-5) \\ =\mathbf{2 0} \end{gathered}$ | $\begin{aligned} & 50 \div \frac{1}{2} \\ & =100 \end{aligned}$ | $\begin{gathered} -12 \cdot \frac{5}{3} \\ =-20 \end{gathered}$ | $\begin{gathered} .25 \\ =\mathbf{1} / \mathbf{4} \end{gathered}$ |

### 1.6 Simplifying Expressions

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

### 1.7 One-Step Equations

1. $x+3-3=15-3$
$\mathbf{x}=12$
2. $x-4+4=20+4$

$$
x=24
$$

3. $6 y / 6=48 / 6 \quad y=8$
4. $\left(\frac{a}{3}\right) 3=(12) 3$

$$
a=36
$$

5. $\mathrm{w}+100-100=-300-100$

$$
w=-400
$$

6. $x-12+12=-20+12$

$$
x=-8
$$

7. $-6 y /-6=48 /-6$ $y=-8$
8. $\left(\frac{a}{3}\right) 3=(-9) 3$
$a=-27$
9. $-5-4=x+4-4$
$-9=x$ or $x=-9$
10. $5 x / 5=7 / 5$
$x=7 / 5$
11. $(1 / 2 x) 2 / 1=(12) 2 / 1$ $x=24$
12. $(3 / 4 \mathrm{x}) 4 / 3=(18) 4 / 3$

$$
\mathbf{x}=72 / 3=24
$$

13. $7 x / 7=7 / 7 \quad x=1$
14. $\mathrm{x}-\frac{1}{2}+\frac{1}{2}=\frac{3}{2}+\frac{1}{2}$

$$
\mathbf{x}=\frac{4}{2}=2
$$

15. $-x /-1=-7 /-1 \quad x=7$
16. $5 x / 5=0 / 5 \quad x=0$

### 1.8 Two-Step Equations

$$
\begin{aligned}
& \text { 1. } 2 x+1-\mathbf{1}=7-\mathbf{1} \\
& 2 x=6 \\
& 2 x / 2=6 / 2 \quad x=\mathbf{3}
\end{aligned}
$$

2. $3 x-1+1=11+1$
$3 \mathrm{x}=12$
$3 x / 3=12 / 3$
$\mathrm{x}=4$
3. $-2 x+1-\mathbf{1}=9-1$
$-2 x=8$
$-2 \mathrm{x} /-2=8 /-2$
$x=-4$

### 1.8 Two-Step Equations (cont.)

4. $-5 x-1+1=9+1$
$-5 x=10$
$-5 x /-5=10 /-5$
$\mathrm{x}=-2$
5. $5+3 x-5=17-5$
$3 \mathrm{x}=12$
$3 x / 3=12 / 3$
$\mathrm{x}=4$
6. $7-3 x-7=13-7$
$-3 x=6$
$-3 \mathrm{x} /-3=6 /-3$
$x=-2$
7. $7-5=5+2 x-5$
$2=2 \mathrm{x}$
$2 / 2=2 x / 2$
$1=x$ or $x=1$
8. $10-3 x-10=13-10$
$-3 x=3$
$-3 x /-3=3 /-3$
$\mathrm{x}=-1$
9. $\left(\frac{x+4}{3}\right) 3=(10) 3$
$x+4-4=30-4$
$\mathrm{x}=26$
10. $\left(\frac{x-7}{5}\right) 5=(2) 5$
$x-7+7=10+7$
$\mathrm{x}=17$
11. $-4 a+2-2=2-2$
$-4 a=0$
$-4 a /-4=0 /-4$
$\mathbf{a}=\mathbf{0}$
12. $\frac{w}{3}-10+10=0+10$
$\left(\frac{w}{3}\right) 3=(10) 3$
$\mathrm{w}=30$

### 1.9 Multi-Step Equations

1. $x+3 x=12$
$4 x=12$
$4 \mathrm{x} / 4=12 / 4$
$\mathrm{x}=3$
2. $5 x-3 x+2=12$
$2 x+2=12$
$2 \mathrm{x}+2-2=12-2$
$2 \mathrm{x}=10$
$2 \mathrm{x} / 2=10 / 2$
$x=5$

### 1.9 Multi-Step Equations

3. $3 x-5 x+2=12$
$-2 x+2=12$
$-2 \mathrm{x}+2-2=12-2$
$-2 x=10$
$-2 \mathrm{x} /-2=10 /-2$
$x=-5$
4. $5(\mathrm{x}-2)=20$
$5 x-10=20$
$5 \mathrm{x}-10+\mathbf{1 0}=20+\mathbf{1 0}$
$5 \mathrm{x}=30$
$5 x / 5=30 / 5$
$x=6$
5. $3(x+1)=15$
$3 x+3=15$
$3 \mathrm{x}+3-3=15-3$
$3 \mathrm{x}=12$
$3 x / 3=12 / 3$
$x=4$
6. $-2(x+4)=16$
$-2 x-8=16$
$-2 \mathrm{x}-8+8=16+8$
$-2 \mathrm{x}=24$
$-2 x /-2=24 /-2$
$\mathrm{x}=-12$
7. $3 \mathrm{x}-\mathrm{x}=\mathrm{x}+4-\mathrm{x}$
$2 \mathrm{x}=4$
$2 x / 2=4 / 2$
$\mathrm{x}=2$
8. $4 \mathrm{x}-2 \mathrm{x}=2 \mathrm{x}+10-2 \mathrm{x}$
$2 \mathrm{x}=10$
$2 \mathrm{x} / \mathbf{2}=10 / 2$
$\mathrm{x}=5$
9. $-5 x+3+5 x=-4 x+5 x$

$$
3=1 \mathrm{x} \quad \text { or } \quad \mathbf{x}=3
$$

10. $x-5-x=2 x-x$
$-5=x$ or $x=-5$
11. $2(x+1)=x-3$ $2 x+2=x-3$
$2 x+2-2=x-3-2$
$2 \mathrm{x}=\mathrm{x}-5$
$2 \mathrm{x}-\mathrm{x}=\mathrm{x}-5-\mathrm{x}$
$x=-5$
12. $-2(x+1)=3 x-7$
$-2 x-2=3 x-7$
$-2 \mathrm{x}-2+7=3 \mathrm{x}-7+7$
$-2 x+5=3 x$
$-2 \mathrm{x}+5+2 \mathrm{x}=3 \mathrm{x}+2 \mathrm{x}$
$5=5 x$
$5 / 5=5 x / 5$
$1=\mathrm{x}$ or $\mathrm{x}=\mathbf{1}$
1.10 Expressions and Equations
13. 3 x
14. $3 \mathrm{x}-12$
15. 4 x
16. $2-\mathrm{x}$ (not like terms)
17. $\mathrm{x}-8$
18. $7-2 x-2$ $=5-2 x$
19. $7-2 \mathrm{x}+2$ $=9-2 x$
20. $3^{1 / 2 x}$ or $3.5 x$
21. $3 x=12$

$$
x=12 / 3=4
$$

10. $3 x-12=5$
$3 x=17$
$x=17 / 3=52 / 3$ or 5.666
11. $4 \mathrm{x}=-20$
$x=-20 / 4=-5$
12. $-x=-8$
$-x /-1=-8 /-1 \quad$ so $\mathbf{x}=8$
13. $\mathrm{x}-8=80$ so $\mathrm{x}=\mathbf{8 8}$
14. $7-2 x-2=-1$
$5-2 x=-1$
$-2 x=-6$
$x=-6 /-2=3$
15. $7-2 x+2=-1$
$9-2 x=-1$
$-2 x=-10$
$\mathbf{x}=-10 /-2=5$
16. $3.5 x=7$
$\mathbf{x}=7 / 3.5=2$

### 1.11 Special Equations

1. $\mathrm{x}=0$ conditional
2. identity
3. contradiction
4. identity
5. contradiction
6. $x=-1$ conditional
7. identity
8. contradiction
9. $x=-1$ conditional
10. identity
11. $\mathrm{x}=0$ conditional
12. $x=3$ conditional
13. $x=1$ conditional
14. contradiction
15. $x=5$ conditional

### 1.12 Solving Inequalities

1 a.


1b. $\{x \mid x>8\}$
1c. $(8, \infty)$

2a.


2b. $\{x \mid x \leq 5 \quad\}$
2c. $(-\infty, 5]$

3a.


3b. $\{x \mid x \geq 6\}$
3c. $[6, \infty)$

4a.


4b. $\{x \mid x<-3\}$ don't forget to FLIP!
4c. $(-3, \infty)$
$5 a$.


5b. $\{x \mid x<4\}$
5c. $(-\infty, 4)$

6 .


6b. $\{x \mid 3<x<5\}$ work with all 3 sections!
6c. $(3,5)$

7 a.


7b. $\{x \mid x<-4\}$
7c. $(-\infty,-4)$

8a.


8b. $\{x \mid x \leq 2\}$
8c. $(-\infty, 2]$

9a.
9b. $\left\{x \mid-\mathbf{1}^{-15} \leq x<2\right\}$
9c. $[-1,2)$

10a.


10b. $\{x \mid x>5 / 2\}$
10c. $\left(\frac{5}{2}, \infty\right)$

### 1.12 Solving Inequalities (cont.)

11a.


11b. $\{x \mid x<12\}$
11c. $(-\infty, 12)$

12a.


12b. $\{x \mid-5<x<-3\}$
12c. $(-5,-3)$
1.13 Color Matching Inequalities

1.14 Career Pathway Applications -STEM (cont.)

1a. $3 \cdot 2=6$ pounds
1b. $3 \cdot 10=\mathbf{3 0}$ pounds
1c. $3 \cdot x=3 x$ pounds

2a. $x+2$
2b. $x-4$
2c. $2 x$
2d. $5 x+3$
2e. $2 x-1$
2f. $2 x-1$

3a. $x+20$ or $20+x$
3b. $x+y$
3c. $x-y$
3d. $1 / 2(x+y)$ or $\frac{x+y}{2}$
3e. $2 x+2 y$ or $2(x+y)$
3f. $\mathbf{x} / 4$ or $1 / 4 x$ or $.25 x$

4a. $R+1.3=6$
$\mathrm{R}+1.3$ - $\mathbf{1 . 3}=6$ - $\mathbf{1 . 3}$
R $=4.7$
4b. $R-2.1=3.9$
$R-2.1+2.1=3.9+2.1$
$\mathbf{R}=5$
4c. $7.2-\mathrm{R}=4.9$
$7.2-\mathrm{R}-4.9+\mathbf{R}=4.9-4.9+\mathbf{R}$
$\mathbf{R}=2.3$
4d. $2 R=7$
$2 R / 2=7 / 2$
R = $3^{1 / 2}$ or 3.5
4e. $.5 R=2.6$
$.5 R / .5=2.6 / .5$
$\mathbf{R}=5.2$
4f. let $\mathrm{R}=$ the younger brother's $\mathrm{RBC}=5.25$
So $\mathrm{R}+1.5$ = older brother's $\mathrm{RBC}=\mathbf{6 . 7 5}$
R + R + 1.5 = 12
$2 R+1.5-\mathbf{1 . 5}=12-1.5$
$2 R / \mathbf{2}=10.5 / \mathbf{2} \quad \mathbf{R}=5.2$
4g. let $\mathrm{R}=$ the healthy sister's $\mathrm{RBC}=3$
So 2 R = the sick sister's $\mathrm{RBC}=\mathbf{6}$
$\mathbf{R}+2 \mathbf{R}=\mathbf{9}$
$3 R / \mathbf{3}=9 / \mathbf{3} \quad \mathbf{R}=\mathbf{3}$

### 1.14 Career Pathway Applications -STEM (cont.)

4h. let $\mathrm{R}=$ the sister's $\mathrm{RBC}=41 / 3$ or 4.333
So $2 R-1$ = the brother's RBC $=72 / 3$ or 7.667

$$
R+2 R-1=12
$$

$$
3 R-1+\mathbf{1}=12+\mathbf{1}
$$

$$
3 R / 3=13 / 3 \quad R=41 / 3 \text { or } 4.333
$$

$$
2 \mathrm{R} / 2=10.5 / 2 \quad \mathbf{R}=5.25
$$

5a. let $\mathrm{x}=$ the updated program $=5.25$

$$
x=100+40=140 \text { gigabytes }
$$

5b. Perimeter $=$ sum of all sides (rectangle has 4 sides)
let width $=\mathrm{W}$ and let length $=\mathrm{W}+4$
$W+W+W+4+W+4=88$
$4 W+8-\mathbf{8}=88-\mathbf{8}$
$4 \mathrm{~W} / 4=80 / 4 \quad \mathrm{~W}=20$
width $=\mathbf{2 0 f t}$. length $=\mathbf{2 4 f t}$.
5b. let width $=\mathrm{W}$ and let length $=2 \mathrm{~W}$

$$
\begin{aligned}
& W+W+2 W+2 W=150 \\
& 6 W / 6=150 / 6 \quad W=25 \\
& \text { width }=25 f t . \text { length }=50 \mathrm{ft} .
\end{aligned}
$$

5b. let $\mathrm{x}=$ the amount insurance will pay

$$
\begin{aligned}
& x=1 / 2(15,000-500) \\
& x=1 / 2(14,500)=\$ 7,250
\end{aligned}
$$

Perimeter $=$ sum of all sides; Area $=$ Length $x$ Width
6a. $P=4 x$ inches $\quad A=x^{2}$ inches
6b. $P=4 x+6$ feet $A=x^{2}+3$ sq. feet
6c. $P=6 x$ miles $\quad A=2 x^{2}$ miles

7a. $x \leq 10$
7b. $x \geq 3$
7c. $3 \leq x \leq 10$
7d. $3 \leq x-1 \leq 10$ or $4 \leq x \leq 11$

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