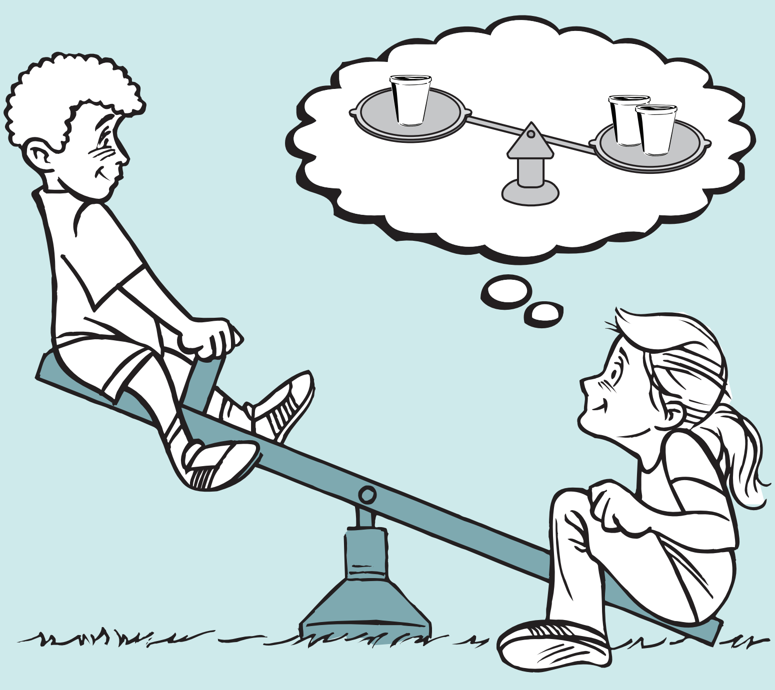
Module 6
Version 03
Sections 1–2

Math 7

Module 6
Equations



BRITISH COLUMBIA

OPEN SCHOOL BC

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Module 6 Table of Contents

Course Overview

Welcome to Mathematics 7!

In this course you will continue your exploration of mathematics. You'll have a chance to practise and review the math skills you already have as you learn new concepts and skills. This course will focus on math in the world around you and help you to increase your ability to think mathematically.

Organization of the Course

The Mathematics 7 course is made up of seven modules. These modules are:

Module 1: Numbers and Operations

Module 2: Fractions, Decimals, and Percents

Module 3: Lines and Shapes

Module 4: Cartesian Plane

Module 5: Patterns

Module 6: Equations

Module 7: Statistics and Probability

Organization of the Modules

Each module has either two or three sections. The sections have the following features:

Pretest	This is for students who feel they already know the concepts in the section. It is divided by lesson, so you can get an idea of where you need to focus your attention within the section.
Section Challenge	This is a real-world application of the concepts and skills to be learned in the section. You may want to try the problem at the beginning of the section if you're feeling confident. If you're not sure how to solve the problem right away, don't worry—you'll learn all the skills you need as you complete the lessons. We'll return to the problem at the end of the section.

Each section is divided into lessons. Each lesson is made up of the following parts:

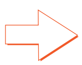
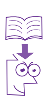
Student Inquiry	Inquiry questions are based on the concepts in each lesson. This activity will help you organize information and reflect on your learning.
Warm-up	This is a brief drill or review to get ready for the lesson.
Explore	This is the main teaching part of the lesson. Here you will explore new concepts and learn new skills.
Practice	These are activities for you to complete to solidify your new skills. Mark these activities using the answer key at the end of the module.

At the end of each module you will find:

Resources	Templates to pull out, cut, colour, or fold in order to complete specific activities. You will be directed to these as needed.
Glossary	This is a list of key terms and their definitions for the module.
Answer Key	This contains all of the solutions to the Pretests, Warm-ups and Practice activities.

Thinking Space

The column on the right hand side of the lesson pages is called the Thinking Space. Use this space to interact with the text using the strategies that are outlined in Module 1. Special icons in the Thinking Space will cue you to use specific strategies (see the table below). Remember, you don't have to wait for the cues—you can use this space whenever you want!

	Just Think It: Questions	Write down questions you have or things you want to come back to.
	Just Think It: Comments	Write down general comments about patterns or things you notice.
	Just Think It: Responses	Record your thoughts and ideas or respond to a question in the text.
	Sketch It Out	Draw a picture to help you understand the concept or problem.
	Word Attack	Identify important words or words that you don't understand.
	Making Connections	Connect what you are learning to things you already know.

More About the Pretest

There is a pretest at the beginning of each section. This pretest has questions for each lesson in the sections. Complete this pretest if you think that you already have a strong grasp of the topics and concepts covered in the section. Mark your answers using the key found at the end of the module.

If you get all the answers correct (100%), you may decide that you can omit the lesson activities.

If you get all the answers correct for one or more lessons, but not for the whole pretest, you can decide whether you can omit the activities for those lessons.

Materials and Resources

There is no textbook required for this course. All of the necessary materials and exercises are found in the modules.

In some cases, you will be referred to templates to pull out, cut, colour, or fold. These templates will always be found near the end of the module, just in front of the answer key.

You will need a calculator for some of the activities and a geometry set for Module 3 and Module 7.

If you have Internet access, you might want to do some exploring online. The Math 7 Course Website will be a good starting point. Go to:

http://www.openschool.bc.ca/courses/math/math7/mod6.html

and find the lesson that you're working on. You'll find relevant links to websites with games, activities, and extra practice. Note: access to the course website is not required to complete the course.

Icons

In addition to the thinking space icons, you will see a few icons used on the left-hand side of the page. These icons are used to signal a change in activity or to bring your attention to important instructions.

Explore Online

Warm-up

Explore

Practice

Answer Key

Use a Calculator

Module 6 Overview

In Module 6, you'll continue to explore patterns and relations. You'll move from expressions to equations and figure out how to tell the difference between them. Once you have a grasp on what equations are, you'll investigate how to solve them.

Section Overviews

Section 6.1: Equality—What Separates Equations from Expressions

You already know a bit about expressions, but what about equations? What's the difference between an expression and an equation? Well, it's all about balancing… and that little equal sign.

In this section you'll explore equality. You'll build on what you know about expressions and start working with equations. Along the way, you'll review the vocabulary you'll need for algebra.

Section 6.2: Solving Equations

Now that you know all about equations, it's time to solve them! In this section you'll learn how to solve several different types of equations. Then, you'll put your algebra skills to good use as you solve a variety of real-world problems.

Section 1

Section 6.1: Equality

Contents at a Glance

Learning Outcomes

By the end of this section you will be better able to:

- describe and demonstrate preservation of equality
- apply the idea of preservation of equality to solve a problem
- identify and provide examples of:
  - a variable
  - a constant term
  - a numerical coefficient
  - an expression
  - an equation
- compare and contrast expressions and equations

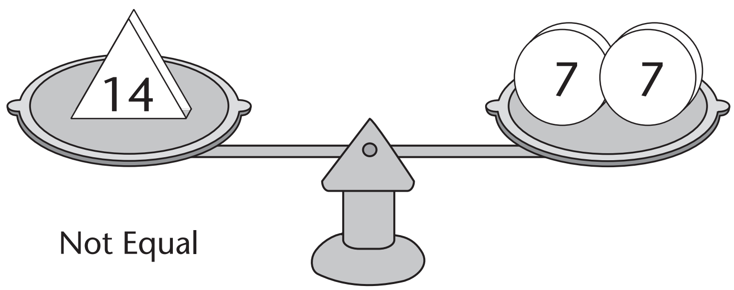
Pretest 6.1

Complete this pretest if you think that you already have a strong grasp of the topics and concepts covered in this section. Mark your answers using the key found at the end of the module.

If you get all the answers correct (100%), you may decide that you can omit the lesson activities.

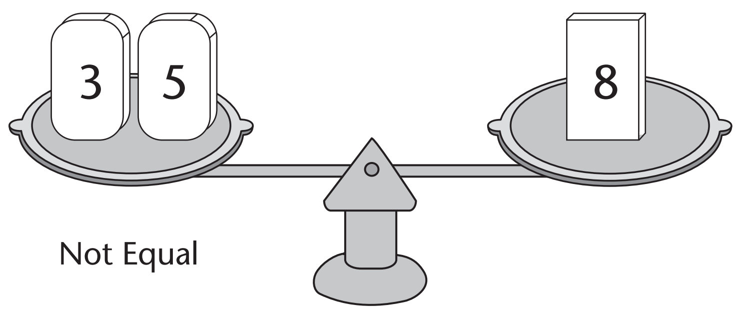
1. Determine if the following balances are equal or not equal. Circle your answer.

   a.



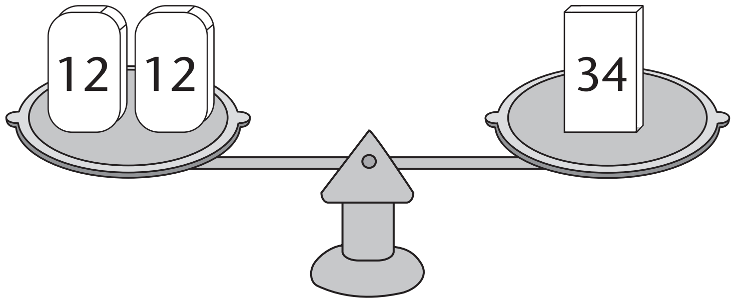
Equal   Not Equal

   b.



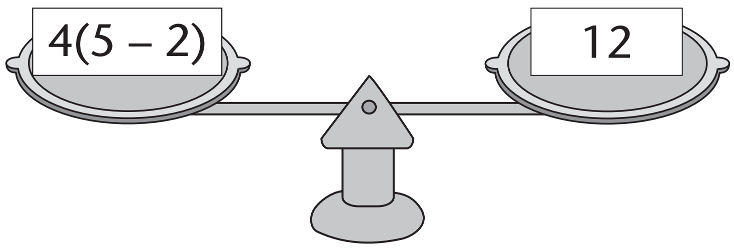
Equal   Not Equal

c.



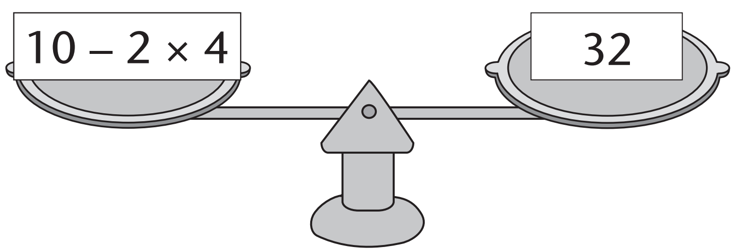
Equal Not Equal

d.



Equal Not Equal

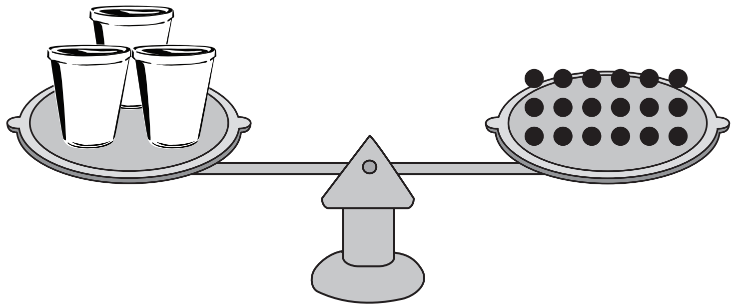
e.



Equal Not Equal

2. Solve the following problems:

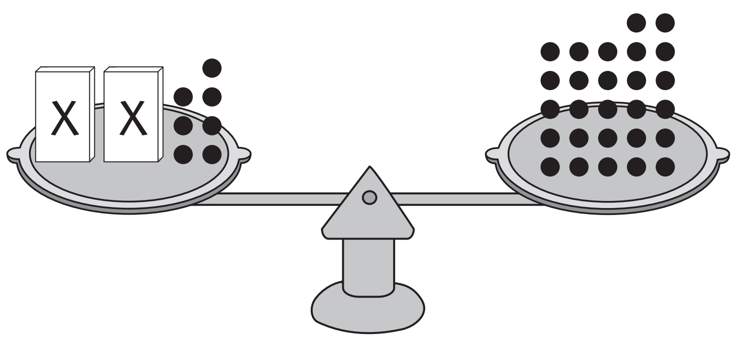
   a.



   How many counters are in each cup?

   If I add one more cup with the same number of counters inside it, how many counters do I need to add to the other side of the scale to keep it balanced?

   b.



   The 7 counters are removed from the right hand side of the scale. How many counters need to be removed from the left hand side?

   What is the value of each block (assume that each block has the same value)?

3. Fill in the blank with either the word “equation” or “expression.”

   a. 3 cups + 4 counters, is an ____________________.

   b. 2 cups + 3 counters = 3 rows of 5 counters each on a balance is an ____________________.

   c. (2 + 3) – 1 = 4, is an ____________________.

   d. 15 = 45 – 5*x*, is an ____________________.

   e. 45 – 5*x*, is an ____________________.

4. Match the sentence with the proper equation on the right.

_____	The sum of six and a number is eleven.	a.	$5x = 35$
_____	Seven less than a number is five.	b.	$6 + x = 11$
_____	The product of five and a number is thirty-five.	c.	$n - 7 = 5$
_____	The sum of a number and 2 is eight.	d.	$\frac{1}{2}h = 12$
_____	One half a number is twelve.	e.	$w + 2 = 8$

5. Match the equation with the correct sentence on the right.

_____	$x - 5 = 3$	a.	A number added to seven equals twelve.
_____	$7 + x = 12$	b.	A number decreased by five is three.
_____	$x \div 4 = 2$	c.	A number times 3 equals 0.
_____	$3x = 0$	d.	Three times the difference of a number and ten is 15.
_____	$8x = 6 + 2$	e.	The product of 8 and a number is the same as six plus two.
_____	$3(x - 10) = 15$	f.	A number divided by 4 is 2.

Turn to the Answer Key at the end of the Module and mark your answers.

Section Challenge

Imagine that you enter a colouring contest to colour a map of the world using only pencil crayons. You will need many different colours to fill in all the different countries.

You have crayons at home, but not pencil crayons, so you go shopping and buy one box of 24 pencil crayons. You start to colour, but you decide that you need more colours. There are many more countries to fill in, and you don't have enough coloured pencil crayons to choose from.

Your brother has some used pencil crayons that he would like to give away, so he gives you two full boxes and one box that has 5 pencil crayons in it. You now have a wonderful assortment of different coloured pencil crayons.

How many used pencil crayons do you have? How many pencil crayons do you have in total (new and used)?

If you're not sure how to solve the problem now, don't worry. You'll learn all the skills you need to solve the problem in this section. Give it a try now, or wait until the end of the section—it's up to you!

Lesson 6.1A: Equality

Student Inquiry

This activity will help you get ready for, learn, and review the information in the upcoming lesson.

When you turn this page over, you will find a chart containing the inquiry outcomes for this lesson. You may be able to answer some of these questions already! Start by writing down your thoughts before the lesson.

When you finish the lesson, answer each question and give an example.

Student Inquiries	BEFORE THE LESSON What I already know about this question:	AFTER THE LESSON What I thought at the end: My final answer, and examples:
What is meant by "preservation of equality"?		answer
		example
Can I explain or demonstrate the preservation of equality for addition, subtraction, multiplication and division using words, objects, pictures and symbols?		answer
		example
How do I apply preservation of equality to solve a problem?		answer
		example

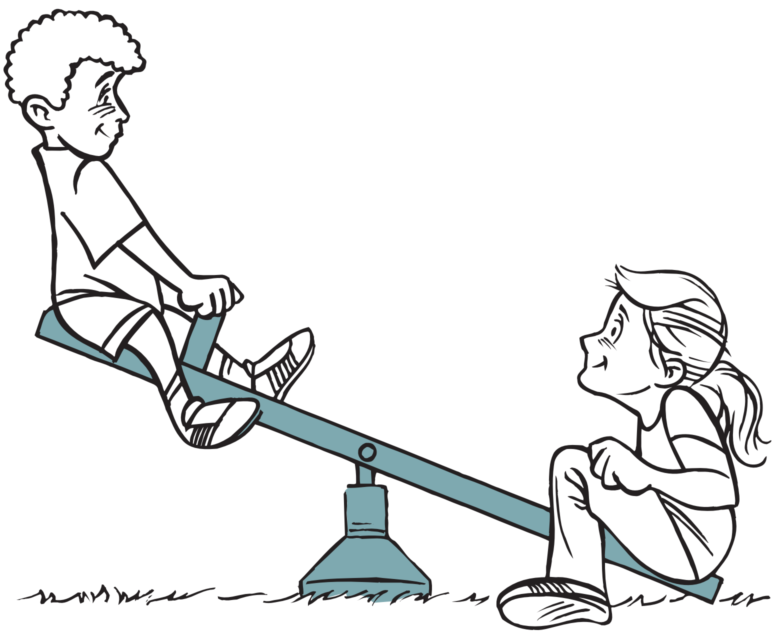
Lesson 6.1A: Equality

Thinking Space

Introduction

Around 1200 years ago, Persian mathematician al-Khwarizmi wrote a book on the basic theory of equations. The word "algebra" comes from the Arabic word "al-jabr" which means balance.

It's useful to think of an equation as a see-saw where one side is balanced with the other side. Imagine that Mark and Jody are on a see-saw together in the park. What happens if Mark gets off the see-saw? The see-saw tilts and goes to the ground on Jody's side. The see-saw is no longer balanced, and the two sides aren't equal any more. Mark can get back on the see-saw, or Jody can get off the see-saw to make it balanced again.



In this lesson, you are going to learn about the preservation of equality for addition, subtraction, multiplication, and division.

Warm-up

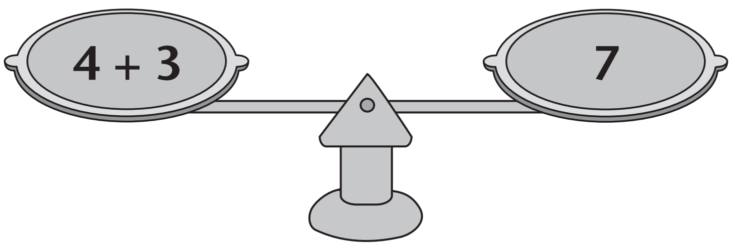
Thinking Space

Usually, we think of an equal sign as leading the way to an answer. You write a question then an equal sign, followed by an answer. For example, 4 + 3 = 7 is thought of as "if I add four plus three, the answer will be equal to 7."

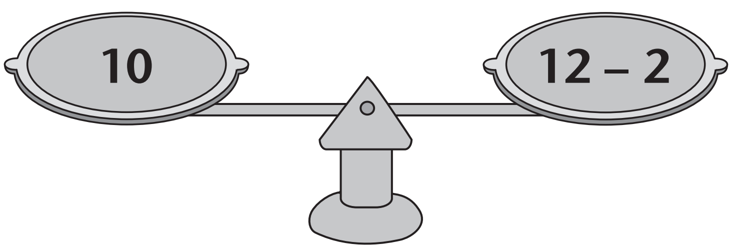
In this lesson, you need to start thinking of the equal sign (=) as something that says one side of the equal sign "is the same as" the other side of the equal sign. The equal sign is the balancing point between the two sides, just like the balancing post on a see-saw.

Examples:

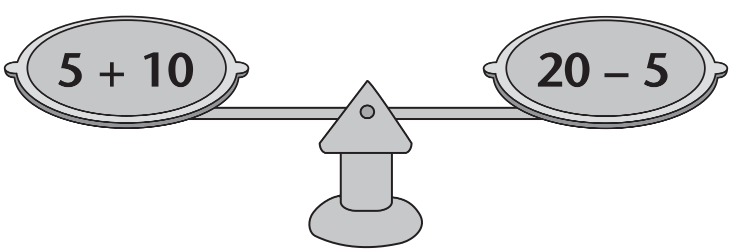
a. $4 + 3 = 7$
   (4 + 3 is the same as 7)



b. $10 = 12 - 2$
   (10 is the same as 12 – 2)



c. $5 + 10 = 20 - 5$
   (5 + 10 is the same as 20 – 5)



Thinking Space

What is an Equation?

An equation is made up of two expressions separated by an equal sign. Both sides of the equal sign are equal to each other.

Remember from Module 5: An **expression** is a phrase made up of a single number or variable, or a combination of numbers and variables combined with operations of addition, subtraction, multiplication, and division.

EXAMPLES OF EXPRESSIONS	EXAMPLES OF EQUATIONS
2x + 2	4 + 3 = 7
x – 3	10 = 12 – 2
5 – x	5 + 10 = 20 – 5

Is 8 + 9 = 20 – 3 an equation?

Yes, it's an equation, both sides are equal: 8 + 9 = 17 and 20 – 3 = 17

Is 6 + 3 – 9 an equation?

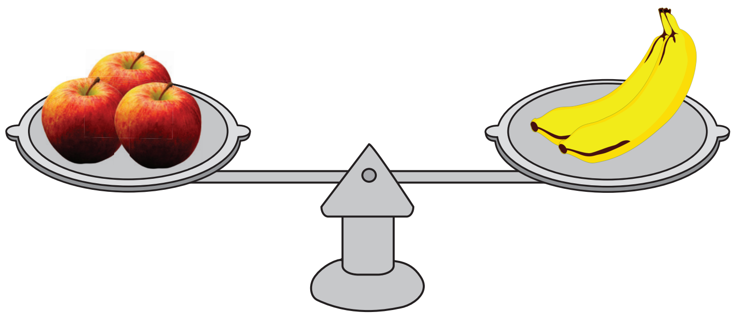
No, 6 + 3 – 9 is not an equation because there is no equal sign.

Is 10 = 6 + 3 an equation?

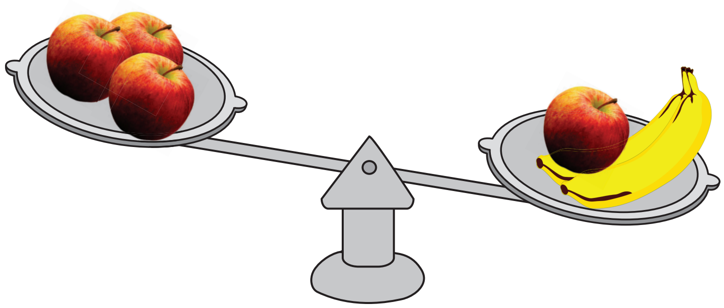
There's an equal sign, but it's not an equation, because both sides are not equal to each other: 6 + 3 is equal to 9, and not 10.

Keep the Scale Balanced

Imagine that you have a scale, as shown below with three apples on one side and two bananas on the other. In the centre of the scale is the fulcrum—the balancing point. The fulcrum is like an equal sign in an equation; both sides of the equation must remain balanced at all times.

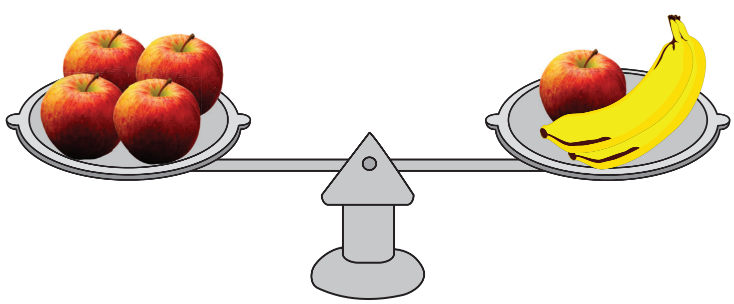


What happens if you add an apple to one side of the scale?



The scale tilts down on the side with the extra apple.

What happens if you add an apple to the other side?



The scale becomes balanced again, and you have preserved the equality of the scale.

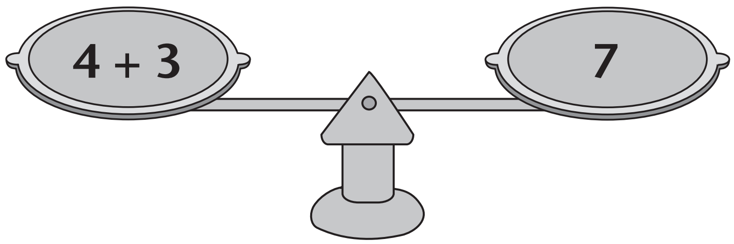
Thinking Space

Thinking Space

It's the same for an equation. We preserve equality by performing the same operation on both sides of the equation.

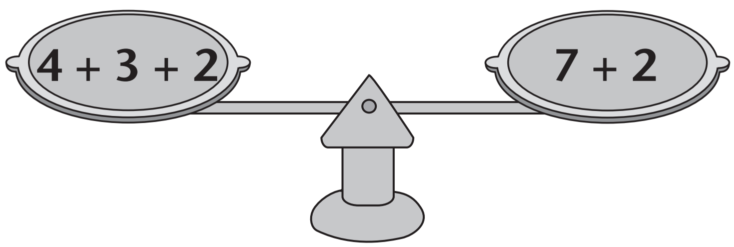
Examples:

1. 4 + 3 = 7

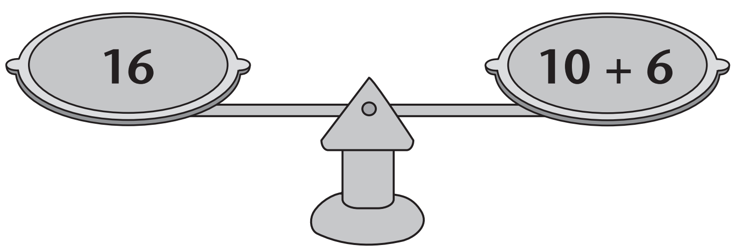


If you add 2 to one side, you must add two to the other side:

4 + 3 + 2 = 7 + 2

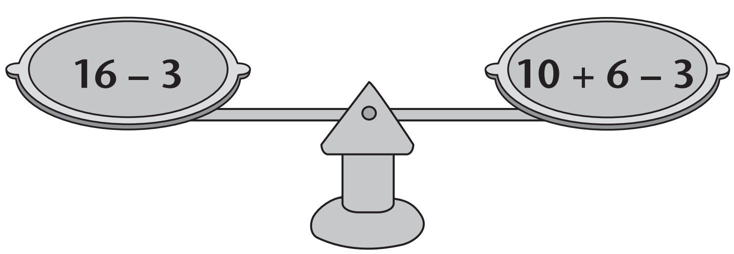


2. 16 = 10 + 6



If you subtract 3 from one side, you must subtract three from the other side.

16 – 3 = 10 + 6 – 3

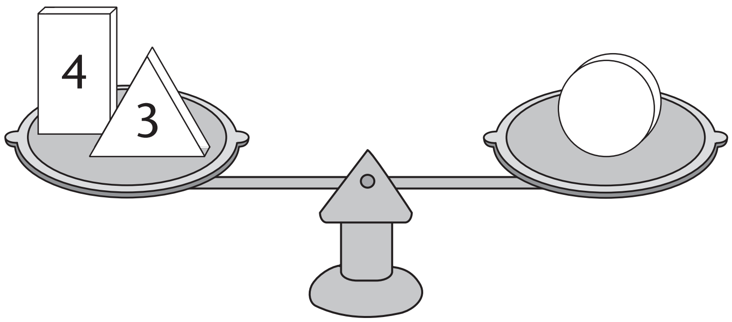


Practice 1

Balance the Scale

Let's get some practice balancing a scale. Look at each scale, and write down an equation that describes the balanced scale.

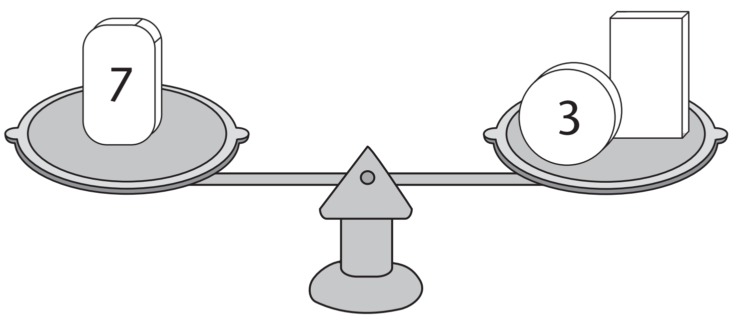
Example:



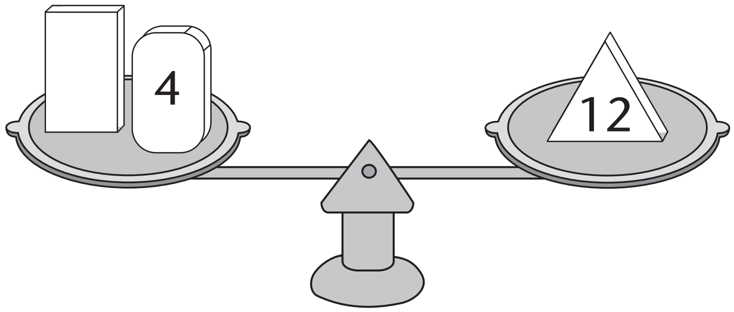
The equation is: 4 + 3 = 7

Now you try!

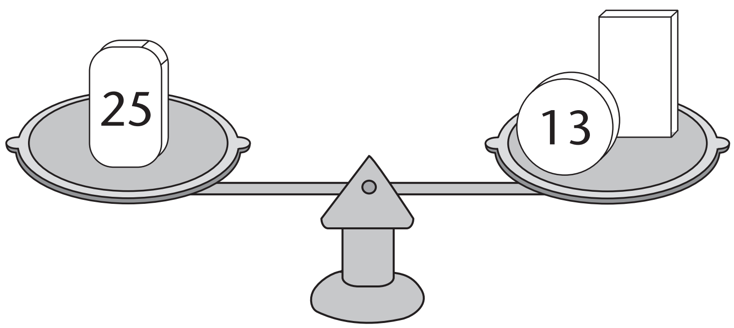
1. The equation is:



2. The equation is:



3. How can you find the value of the unmarked block? Describe the method you used, and give the answer.

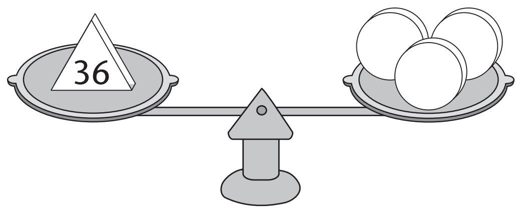


Turn to the Answer Key at the end of the Module and mark your answers.

Explore

Thinking Space

In the last question of Practice 1 you had to describe the method you used to find the value of the box on the scale. Let's work through another example, but this time there are three missing values!



How can you find the value of each block? Try to figure it out on your own first, (use your thinking space) and then go through the solution shown below.

Since each block is the same size, they must weigh the same on the scale. This means that each block is the same value.

Method 1:

You could add up three of the same numbers to find three that add to 36.

$10 + 10 + 10 = 30$ (close)
$11 + 11 + 11 = 33$ (closer)
$12 + 12 + 12 = 36$ (correct)
So, the value of each block is 12.
The equation is: $36 = 12 + 12 + 12$

Method 2:

You could divide the number 36 by 3 to the value of each block.

$36 \div 3 = 12$

Again, the value of each block is 12.

The equation is: $36 \div 3 = 12$

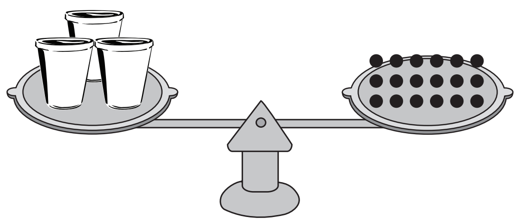
Or you can write: $36 = 3 \times 12$

Preserving Equality

You can add, subtract, multiply, and divide on both sides of the equation. You must remember that what you do to one side of the equal sign, you must do to the other. It's important that you preserve the equality, or it's no longer an equation. Each side of the equal sign must equal the other.

What you do to one side of the equation, you MUST do to the other side.

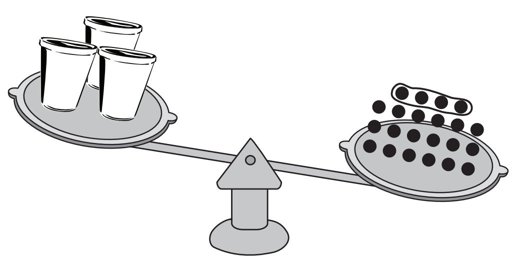
A. Addition



This scale is balanced. It doesn't matter how many counters are in each cup. All we need to know is that the scale is balanced.

3 cups = 18 counters
OR
$3x = 18$

What happens if we add four counters to one side of the balance?



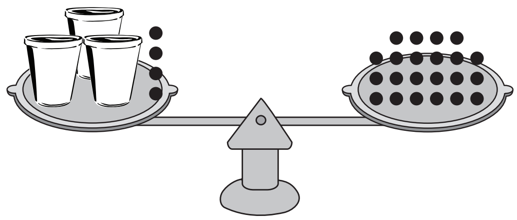
Thinking Space

?

Can an equation have two (or more) equal signs in it? Would $12 + 12 + 12 = 3 \times 12 = 36 \div 3$ be an equation?

Thinking Space

To preserve equality, we have to add four counters to the other side of the balance as well.



$$3x + 4 = 18 + 4$$
$$3x + 4 = 22$$

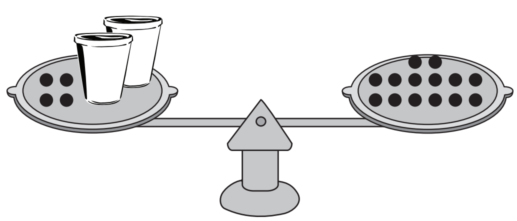
If we want to add 4 to one side, we have to add 4 to the other side.

Fill in the blanks:

What you do to _____ _________ of the equation, you MUST do to the _________ _____.

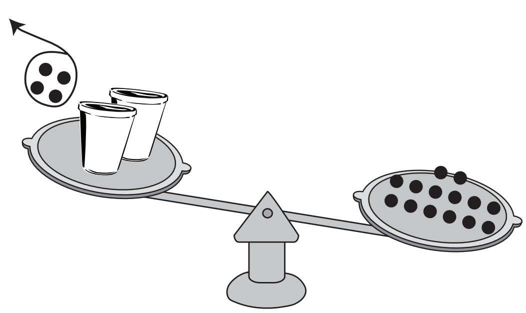
B. Subtraction

This scale is also balanced.



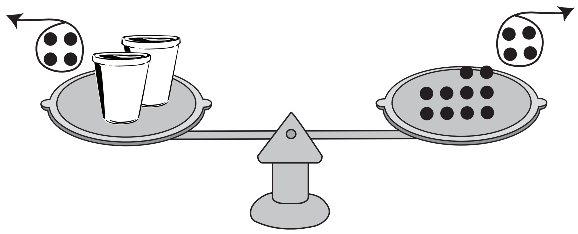
2 cups and 4 counters = 14 counters
$$2x + 4 = 14$$

If we remove four counters from the left side of the balance, how do we preserve equality? What do we have to do?

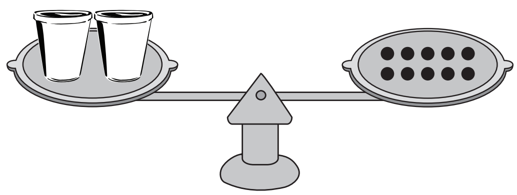


Thinking Space

We have to subtract four counters from the other side, too.



$$2x + 4 - 4 = 14 - 4$$
$$2x = 10$$



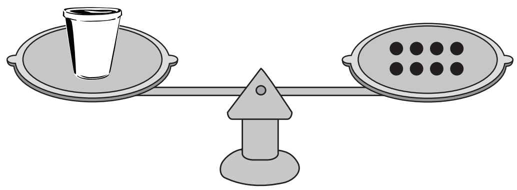
If we want to subtract four from one side, we have to subtract four from the other side, too.

+ 4 − 4 = 0.

What you do __ _____ ________ __ ___ ________,
you MUST do __ _____ ________ _____.

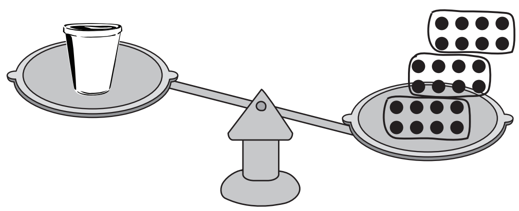
C. Multiplication

This scale is balanced.

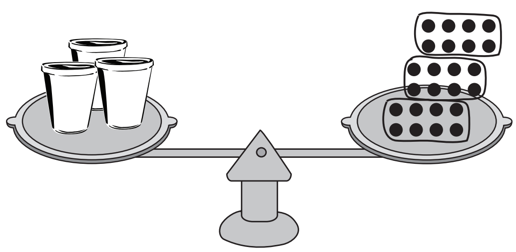


$x = 8$

If we multiply by three on one side of the equation,



we have to multiply by three on the other side, too.

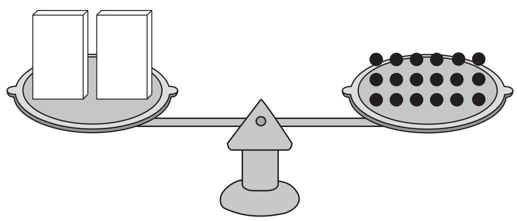


$3(\ x\ ) = 3\ (\ 8\ )$
3(8) means 3 x 8
$3x = 24$

Thinking Space

3(x) means 3 × ?
3(8) means 3 × 8

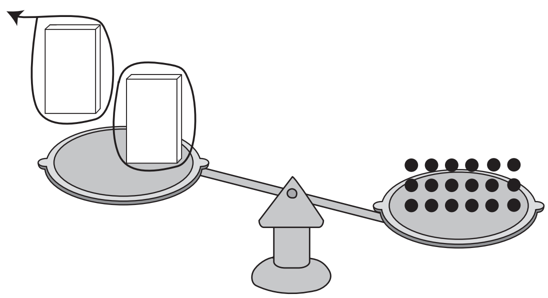
D. Division



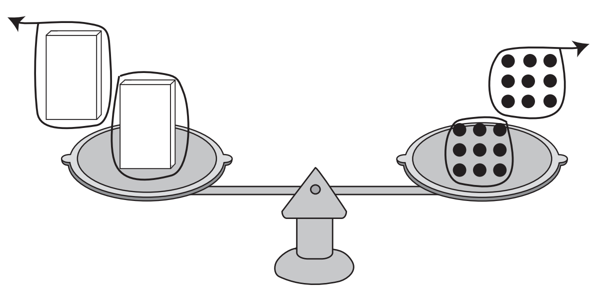
This scale is balanced.

$$2 \text{ blocks} = 18 \text{ counters}$$
$$2x = 18$$

If we divide by two on one side of the equation,



we have to divide by two on the other side, too.



$$\frac{2x}{2} = \frac{18}{2}$$
$$x = 9$$

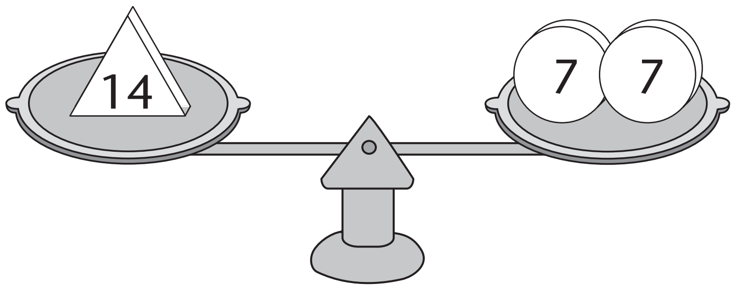
What you do __ _____ _________ __ ___ _________, you MUST do __ _____ _________ _____.

Thinking Space

Practice 2

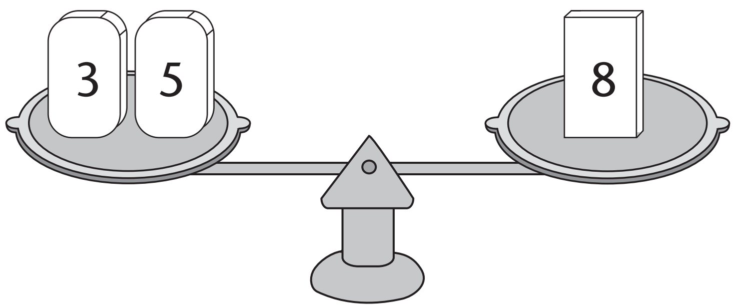
1. Determine if the following balances are equal or not equal.

   a.



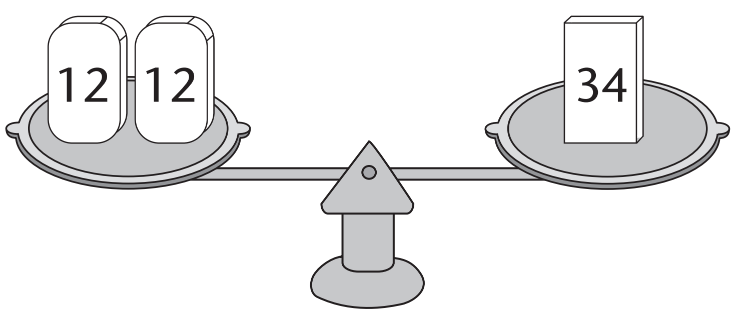
Equal Not Equal

   b.



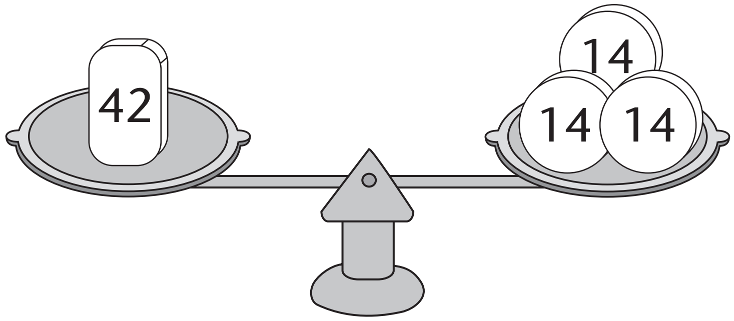
Equal Not Equal

   c.



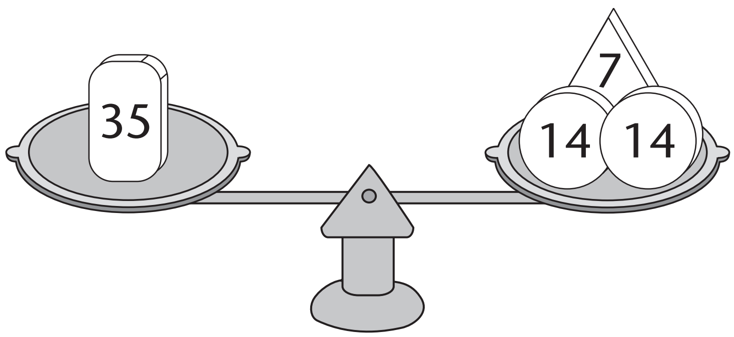
Equal Not Equal

d.



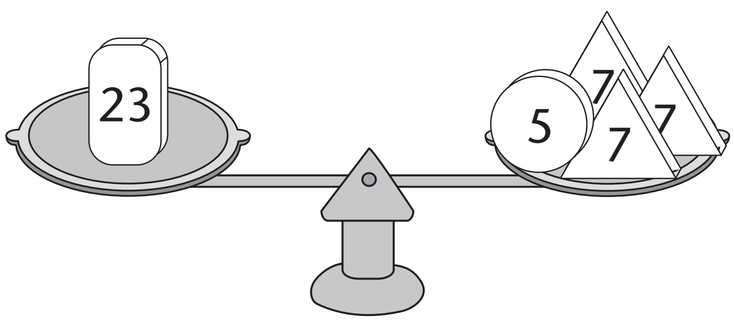
Equal Not Equal

e.



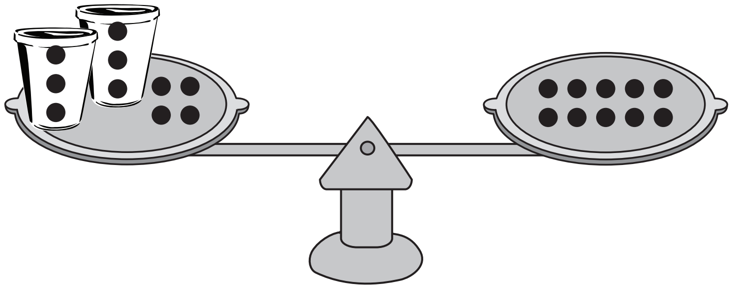
Equal Not Equal

f.



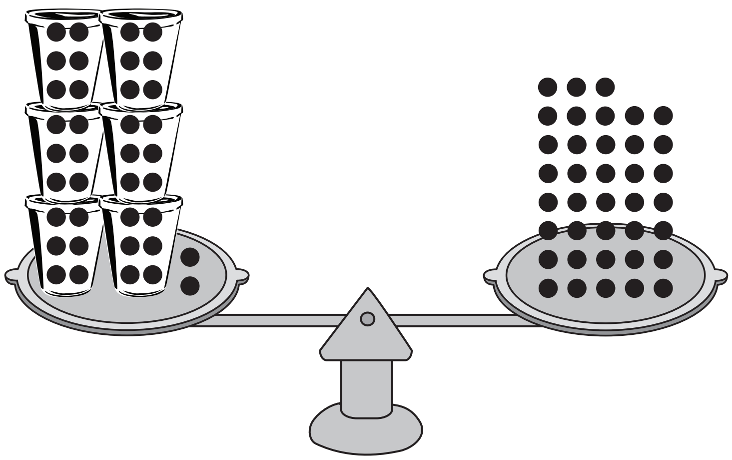
Equal Not Equal

g.



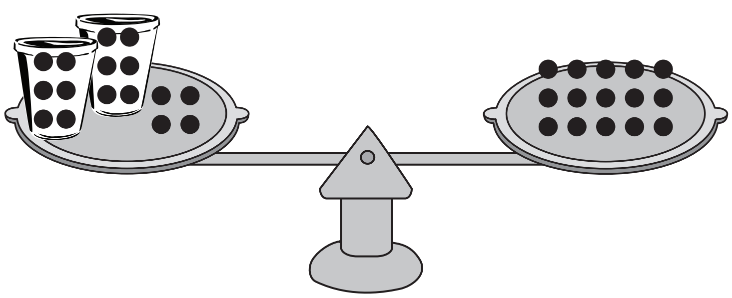
Equal Not Equal

h.



Equal Not Equal

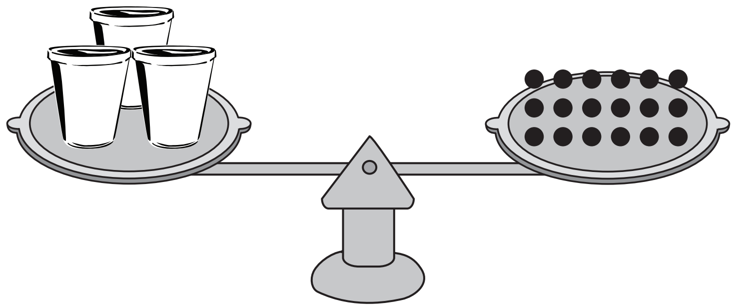
i.



Equal Not Equal

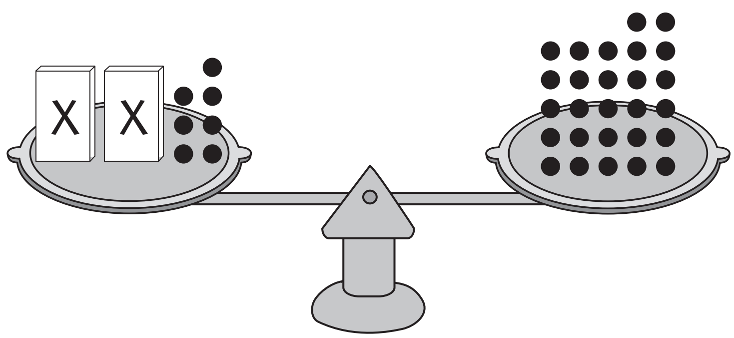
2. Solve the following problems:

   a.



How many counters are in each cup?

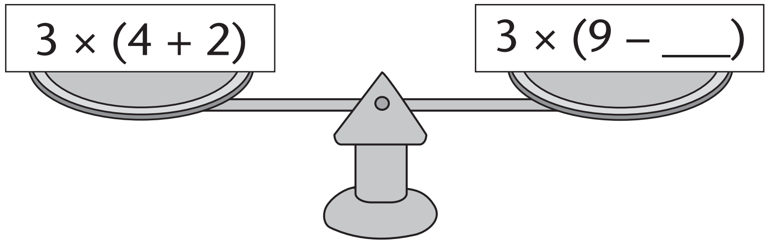
   b.



The 7 counters are removed from the right hand side of the scale. How many counters need to be removed from the left hand side?

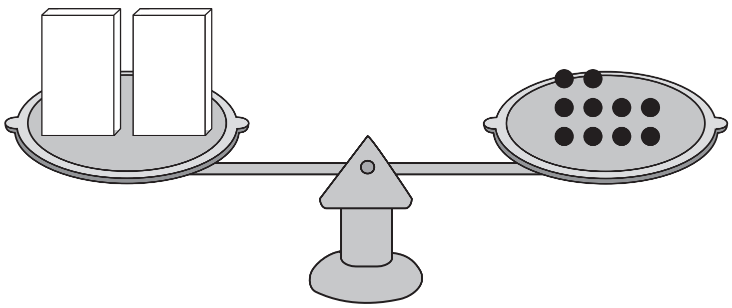
What is the value of each block (assume that each block has the same value)?

c.



d. 4 × 10 counters = 10 counters + __________ counters

e.



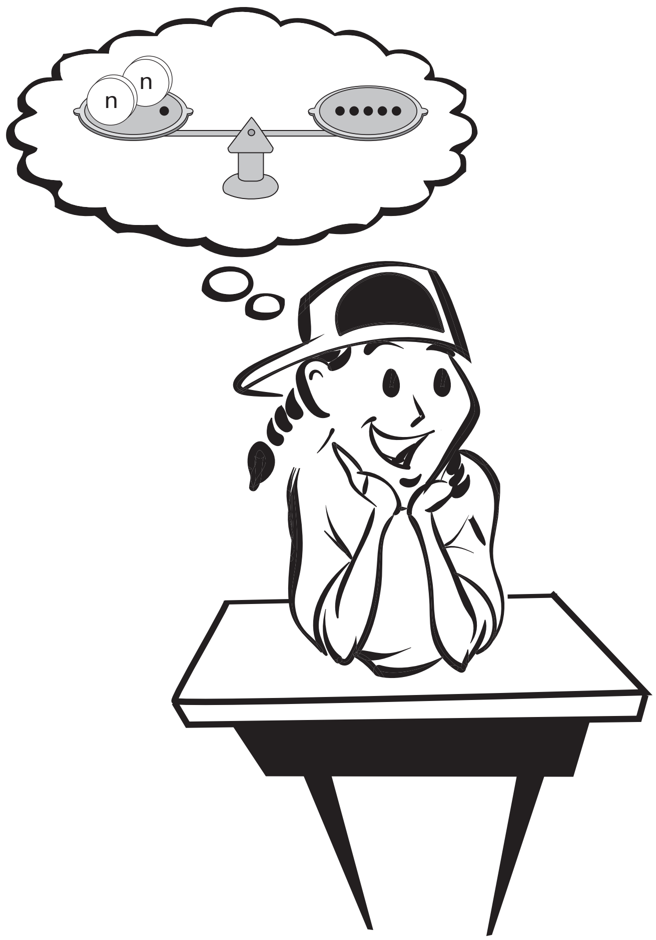
If 1 block is removed from the scale, how many counters from the other side need to be removed?

3. Write 5 different equations that are equal to 12.
Eg. 10 + 2 = 12 or 12 × 1 = 12

Turn to the Answer Key at the end of the Module and mark your answers.

Lesson 6.1B: The Language of Equations

Student Inquiry



This activity will help you get ready for, learn, and review the information in the upcoming lesson.

When you turn this page over, you will find a chart containing the inquiry outcomes for this lesson. You may be able to answer some of these questions already! Start by writing down your thoughts before the lesson.

When you finish the lesson, answer each question and give an example.

Student Inquiries	BEFORE THE LESSON	AFTER THE LESSON
	What I already know about this question:	What I thought at the end: My final answer, and examples:
What is a variable and how is it used in a given expression?		answer
		example
How can I identify and provide an example of: • a constant term? • a numerical coefficient? • an expression? • an equation?		answer
		example
How are equations similar to expressions?		answer
		example
How are equations different from expressions?		answer
		example

Lesson 6.1B: The Language of Equations

Introduction

Why are algebraic equations useful?

As described in this module, algebraic equations are a unique language made up of numbers, letters and symbols. (Algebra is also a universal language, meaning that it is used by people in many different countries.) Algebraic equations are useful because they help us to interpret problems and organize the information into number sentences. They provide scientists, engineers, chemists, economists, business persons, bankers and many others with a valuable tool for organizing ideas and solving problems.

Learning how to use algebra will help you in your other courses, like Science and Social Studies, and in your future career. The skills you gain by learning algebra will help you:

- organize your ideas
- show how you arrive at an answer, and
- prove that your answer is correct.

So even if algebra looks like an awkward way to solve a simple problem that you could more easily do in your head, it is a skill worth learning and building on!

Thinking Space

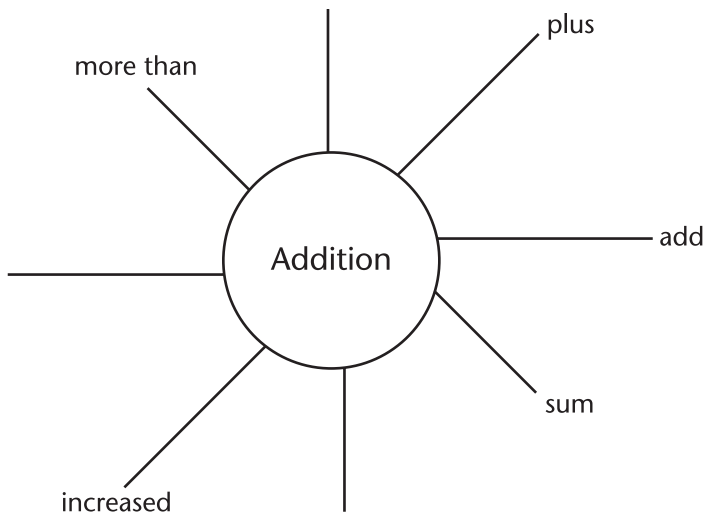
?

Algebra seems like an awkward way to solve problems. I can solve most of these questions in my head, so why write an algebraic equation?

Warm-up

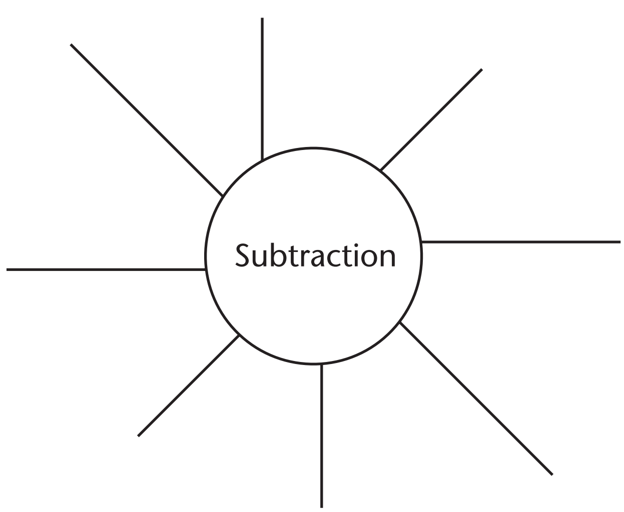
Thinking Space

Let's use a web to brainstorm all the different ways you can say "addition."

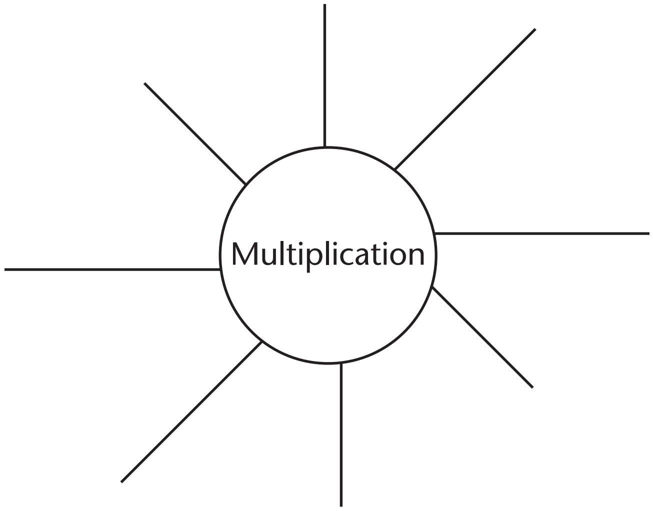


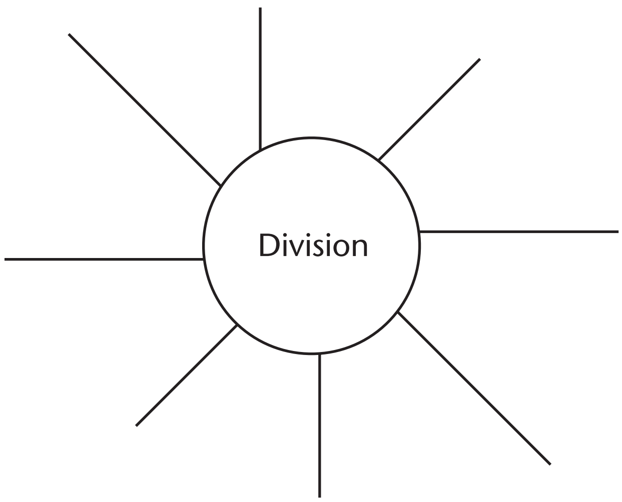
That's 5 different ways to say "addition." Can you add any more words to the addition web?

Now draw a web for subtraction, multiplication, and division, and brainstorm the different words to describe these operations.



Thinking Space





In the previous section, you learned about expressions.

For Example:

2n + 1 translates to twice a number plus one.

Expressions can include single numbers, single variables or a combination of variables and numbers combined with operations of +, −, ×, ÷.

Here are some more expressions:
$x + 1$
$2 + 2$
$3x - 7$
$5a + 2b$

In this lesson, you will compare expressions with equations. We'll explore how they are similar and how they're different.

Explore
Terms

Terms are the "words" that make up an expression or equation. They can be a number, a letter, or a product of a number and letter. Terms are separated by addition or subtraction signs. Look at the examples below:

EXAMPLE	TRANSLATION	TERMS
$10 + 3x = 16$	Ten plus the product of three and x equal sixteen	$10, 3x, 16$
$2ab + 3ab = 5ab$	Two times the product of a and b plus three times the product of a and b equals five times the product of a and b	$2ab, 3ab, 5ab$

Remember:

- $a \times b$ is written as ab
- $ab = ba$, but $57 \neq 75$
- ab is the product of a and b: $a \times b$
- ba is the product of b and a: $b \times a$

Variable

1. A **variable** in an expression represents an "unknown."

Example:

$2n + 1$, "n" can change in value:

Substituting $n = 2$,
$2(2) + 1 = 5$

Substituting $n = 3$,
$2(3) + 1 = 7$

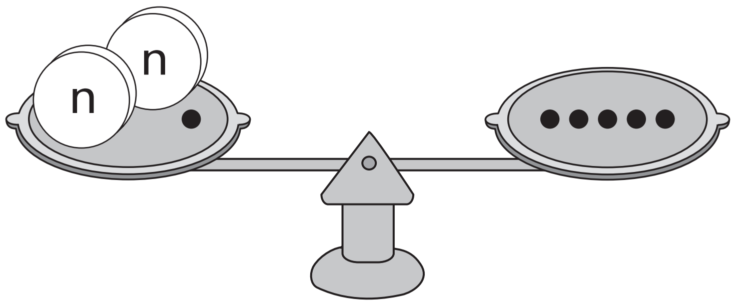
Thinking Space

I learned about terms in Module 5.

Thinking Space

2. A variable in an equation is an "unknown" quantity of something that can be solved.

Example:



$$2n + 1 = 5$$
$$2(2) + 1 = 5$$
$$n = 2$$

Example:

There are 12 eggs in a carton. If you have 48 eggs in total, how many cartons do you have?

Let the variable "n" equal the number of cartons.

12 eggs × "n" number of cartons = total # of eggs
$12n = 48$
You know that $12 \times 4 = 48$, so $n = 4$
There are 4 cartons of eggs.

Coefficient

A **coefficient** is the number value in front of a variable.

Example:

$5a$
coefficient = 5
variable = a

If there is no coefficient in front of a variable, the coefficient is understood to be 1.

Thinking Space

Example:

a
coefficient = 1
variable = a

So $1a$ and a mean the same thing.

Constant Term

A **constant term** is a term that is not multiplied or divided by a variable. It remains a constant value.

Example:

$3x + 2$
2 is a constant term
$3x$ is not a constant term

What is the difference between 2 and $3x$ in this expression?

$3x$ and 2 are both terms, but only 2 is a constant term. Many different numbers can be substituted for x, so the term $3x$ can change.

Example:

$2x + 5$
constant term = 5

Practice 1

1. List the coefficients and variables for the terms in the following equations:

EQUATION	COEFFICIENTS	TERMS	VARIABLES
$x + 5y = 11$			
$4a - b = 26$			

2. Name the numerical coefficient in each.

   a. $8x$
   Coefficient:

   b. xy
   Coefficient:

   c. $5m$
   Coefficient:

   d. $\frac{1}{2}x$
   Coefficient:

   e. a
   Coefficient:

   f. $1.4x$
   Coefficient:

   g. $11xy$
   Coefficient:

3. Name the constant term in the following examples:

   a. $3x + 2$
      Constant term =

   b. $2b + 7$
      Constant term =

Turn to the Answer Key at the end of the Module and mark your answers.

Explore

Similarities and Differences Between Equations and Expressions

Thinking Space

Similarities

EXPRESSIONS include:	EQUATIONS include:
• a single number • a single variable, • a combination of numbers and variables • single operations or a combination of operations: +, –, ×, or ÷ Example: $3x + 1$ $16 - 3$	• a single number • a single variable, • a combination of numbers and variables • single operations or a combination of operations: +, –, ×, or ÷ • Equations are made up of two expressions separated by an equal sign Example: $3x + 1 = 16 - 3$

Differences

EXPRESSIONS:	EQUATIONS:
• an expression is a mathematical phrase • you can only simplify an expression • you can't solve an expression • there is no equal sign in an expression Example: five less than a number $x - 5$ "x" can be many different numbers	• an equation is an algebraic sentence • you can solve an equation • an equation includes an equal sign • one side of an equation is balanced with the other side Example: five less than a number is 10 $x - 5 = 10$ $x = 15$

Practice 2

1. Fill in the blank with either the word "equation" or "expression."

   a. 3 cups + 4 counters, is an ____________________.

   b. 2 cups + 3 counters = 3 rows of 5 counters each on a balance is an ____________________.

   c. $5x + 3$, is an ____________________.

   d. $(2 + 3) - 1$, is an ____________________.

   e. $(2 + 3) - 1 = 4$, is an ____________________.

   f. $18 = 6 + 7 + 5$, is an ____________________.

   g. $15 = 45 - 5x$, is an ____________________.

   h. $45 - 5x$, is an ____________________.

Turn to the Answer Key at the end of the Module and mark your answers.

Explore
Translating Words to Symbols

Thinking Space

In the warm-up, you brainstormed different ways to say addition, subtraction, multiplication and division. For example, addition can also be written as add, sum, more than, increased, or plus.

Let's review words and symbols that are used to describe mathematical operations. For example, plus is written as a "+" sign in an expression, and minus is written as a "–" sign. It is important to be able to translate word sentences into algebraic sentences.

Practice 3

1. Fill in as many of the expressions as you can in the right hand column using "n" as the number:

Table with Operational Symbols

WORD	OPERATION	SYMBOL	EXAMPLE	LET n = NUMBER
a. plus	add	+	a number plus five	$n + 5$
b. minus	subtract	–	a number minus three	
c. more than	add	+	six more than a number	
d. less than	subtract	–	two less than a number	
e. increased by	add	+	a number increased by four	
f. decreased by	subtract	–	a number decreased by one	
g. the sum of	add	+	the sum of a number and seven	
h. the difference between	subtract	–	the difference between a number and one	
i. the product of	multiply	×	the product of a number and four	

j. the quotient of	divide	÷	the quotient of a number and five	
k. twice	multiply by 2	× 2	twice a number	
l. triple	multiply by 3	× 3	triple the sum of a number and four	
m. half	multiply by ½ or divide by 2	× ½ or ÷ 2	half a number	
n. of	multiply	×	one-third of a number	

Turn to the Answer Key at the end of the Module and mark your answers.

Explore

Translating Words to Equations

Thinking Space

The following words and phrases translate to an equal sign in an equation:

- is
- equals
- is the same as
- the result is

Example:

A number increased by four is seven.
Let n = a number
Equation: $n + 4 = 7$

Before you translate words into algebraic equations, you will find it helpful to highlight key words. You'll want to highlight the words for terms, operations, and the answer.

Examples:

The product of four and a number is twenty.

The **product** of four and a number is **twenty**.

Equation: $4 \times n = 20$, or $4n = 20$

The sum of twice a number and ten is sixteen.

The **sum** of twice a number and ten is **sixteen**.

Equation: $2n + 10 = 16$

Translating Equations to Words

Let's translate algebraic equations back into words. Review the *Table with Operational Symbols* if you are having difficulty.

Example:

$x + 7 = 10$
Sentence: A number plus seven equals ten.

Practice 4

1. Translate these equations into words, letting "x" be a number.

   a. $4 + x = 6$
   Sentence:

   b. $x - 3 = 9$
   Sentence:

   c. $2 + x = 7$
   Sentence:

   d. $3x = 12$
   Sentence:

   e. $5x + 1 = 37$
   Sentence:

2. Match the sentence with the proper equation on the right.

_____	The sum of six and a number is eleven.	a.	$4(2x) = 16$
_____	Seven less than a number is five.	b.	$6 + x = 11$
_____	The product of five and a number is thirty-five.	c.	$n - 7 = 5$
_____	The sum of a number and 2 is eight.	d.	$\frac{1}{2}h = 12$
_____	One half a number is twelve.	e.	$2(x + 3) = 18$
_____	Four increased by a number is sixteen.	f.	$4 + x = 16$
_____	The product of four and twice a number is sixteen.	g.	$w + 2 = 8$
_____	Twice the sum of a number and three is eighteen.	h.	$5x = 35$

3. Match the equation with the correct sentence on the right.

_____	$x - 5 = 3$	a.	A number added to seven equals twelve.
_____	$7 + x = 12$	b.	A number decreased by five is three.
_____	$x \div 4 = 2$	c.	A number times 3 equals 0.
_____	$3x = 0$	d.	Three times the difference of a number and ten is 15.
_____	$8x = 6 + 2$	e.	Five multiplied by the product of 2 and a number equals 40.
_____	$5(2x) = 40$	f.	The product of 8 and a number is the same as six plus two.
_____	$3(x - 10) = 15$	g.	A number divided by 4 is 2.

Turn to the Answer Key at the end of the Module and mark your answers.

Section Summary

You should now have the skills to solve the Section Challenge, but you might find it helpful go through this review section on how to:

- preserve equality in an equation
- know the difference between equations and expressions
- translate algebraic equations into words
- translate words into algebraic equations

Preserve Equality in an Equation

You can add, subtract, multiply, and divide quantities to both sides of the equation. Just remember that what you do to one side of the equal sign, you must do to the other. It's important that you preserve the equality, or it's no longer an equation. Each side of the equal sign must equal the other.

What you do to one side of the equation, you must do to the other side.

The Difference Between Equations and Expressions

These are examples of equations: $3x + 2 = 11$, $6 + 3 = 11 - 2$

Equations:

- Equations include single numbers, single variables or a combination of variables and numbers.
- Equations include single operations or a combination of operations: $+$, $-$, $\times$ or $\div$.
- An equation is an algebraic sentence.
- You can solve an equation.
- An equation includes an equal sign.
- One side of an equation is balanced with the other side.
- Equations are made up of two expressions separated by an equal sign.

These are examples of expressions: $3x + 1$, $16x - 3$, $x \div 5$, $15 + 3$

Expressions:

- Expressions include single numbers, single variables or a combination of variables and numbers.
- Expressions include single operations or a combination of operations: +, –, × or ÷.
- An expression is a mathematical phrase.
- You can only simplify an expression.
- You can't solve an expression.
- There is no equal sign in an expression.

Translate Algebraic Equations into Words

Terms are the "words" that make up an expression or equation. A term can be a number, a letter, or a product of a number and letter. Terms are separated by addition or subtraction signs.

A variable in an equation is an "unknown" quantity of something.

A numerical coefficient is the number value in front of a variable. If there is no coefficient in front of a variable, the coefficient is understood to be 1.

A constant term is a term that is not multiplied or divided by a variable. It remains a constant value.

Translate Words into Algebraic Equations

Translate "a number increased by four is seven" into an algebraic equation.

Step 1: Let a variable equal the unknown number.
e.g. Let x = unknown number.

Step 2: Translate the words into an algebra equation.
e.g. Equation: $x + 4 = 7$

Section Challenge

Imagine that you enter a colouring contest to colour a map of the world using only pencil crayons. You will need many different colours to fill in all the different countries.

You have crayons at home, but not pencil crayons, so you go shopping and buy one box of 24 pencil crayons. You start to colour, but you decide that you need more colours. There are many more countries to fill in, and you don't have enough coloured pencil crayons to choose from.

Your brother has some used pencil crayons that he would like to give away, so he gives you two full boxes and one box that has 5 pencil crayons in it. You now have a wonderful assortment of different coloured pencil crayons.

1. How many used pencil crayons do you have?

2. How many pencil crayons do you have in total (new and used)?

Section
2

Section 6.2: Solving Equations

Contents at a Glance

Learning Outcomes

By the end of this section you will be better able to:

- identify different types of linear equations
  - $ax + b = c$
  - $ax = b$
  - $\frac{x}{a} = b, a \neq 0$
- use a linear equation to represent a problem
- solve a linear equation and check your answer

Pretest 6.2

Complete this pretest if you and your teacher think that you already have a strong grasp of the topics and concepts covered in this section. Mark your answers using the key found at the end of the module.

If you get all the answers correct (100%), you and your teacher may decide that you can omit the lesson activities and go directly to the assignments.

If you get all the answers correct for one or more lessons, but not for the whole pretest, you and your teacher can decide whether you can omit the activities for those lessons.

Record your pretest score in the box on the cover page of the Section 3.2 Assignment.

Lesson 6.2A

1. Fill in the blanks.

a.

$$3x = 24$$
$$\frac{3x}{(\div \_\_\_)} = \frac{24}{(\div \_\_\_)}$$
$$x = \_\_\_\_$$

b.

$$5x = 50$$
$$\frac{5x}{(\div \_\_\_)} = \frac{50}{(\div 5)}$$
$$x = \_\_\_\_$$

2. Fill in the blanks.

a.

$$\frac{n}{3} = 12$$
$$(\times 3)\frac{n}{3} = 12(\times 3)$$
$$n = \_\_\_$$

b.

$$\frac{n}{4} = 72$$
$$(\times 4)\frac{n}{4} = 72(\times 4)$$
$$n = \_\_\_$$

c.

$$\frac{n}{5} = 35$$
$$(\times \_\_)\frac{n}{5} = 35(\times \_\_)$$
$$n = \_\_\_$$

3. Solve for the variable.

   a. $5r = 15$

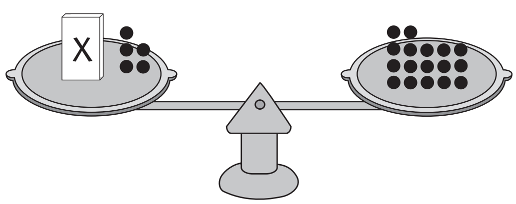
   b. $7q = 42$

   c. $\frac{x}{3} = 15$

4. Joshua has a number of coloured pencils in his pencil case. During art class, he gives 9 away to his friends and has only 3 left. How many pencils did Joshua have in his pencil case before he gave 9 away?

Lesson 6.2B

1. There is one block and 5 counters on one side of a scale balanced with 17 counters on the other side of the scale.



   a. Write down an equation to represent the scale.

   b. Solve for the value of one block.

   c. Check your answer.

2. Fill in the blanks in the following equations and check your solution.

a.

$$4a = 32$$

$$\begin{aligned} 4a &= 32 \\ (\div 4) & \quad (\div 4) \\ a &= \_\_\_ \end{aligned}$$

b.

$$\frac{1}{3}a = 21$$

$$(\times 3)\frac{1}{3}a = 21(\times \_\_)$$

$$a = \_\_\_$$

c.

$$8x = 32$$

$$\begin{aligned} 8x &= 32 \\ (\div \_\_) & \quad (\div \_\_) \\ x &= \_\_\_ \end{aligned}$$

d.

$$\frac{1}{2}b = 6$$

$$(\times \_\_)\frac{1}{2}b = 6(\times \_\_)$$

$$b = \_\_\_$$

3. Evaluate if $d = 4$

a. $3d$

b. $\frac{8}{d}$

c. $21d$

d. $\frac{d}{2}$

Lesson 6.2C

Solve the following equations showing all work. Check your answer.

a. $3 + x = 8$

b. $q - 11 = 18$

Lesson 6.2D

Solve the following word problems using these steps:

Let n = a number

Step 1: Write a let statement to name the variable that represents the unknown number.

Step 2: Translate the word problem into an algebraic equation.

Step 3: Solve for the variable by isolating a single variable on one side. Show your work.

Step 4: Verify your solution.

1. The sum of twice a number and eight is thirty. What is the number?

2. The product of 5 and a number less 4 is 11. What is the number?

3. A number divided by three plus 6 equals 10.

Turn to the Answer Key at the end of the Module and mark your answers.

Section Challenge

Imagine you are participating in a math contest, and you need to answer a skill-testing question. You, along with several other students, are each asked to solve a different type of math question. Your name has come up under the algebra category. You're not worried because there is still plenty of time before you have to answer the question. You can finish Module 6 and learn how to solve one-term and two-term algebra questions and then be able to answer the skill-testing algebra question.

Here's the problem you have to solve:

Tony has picked raspberries and put them into a pail. The weight of the pail with raspberries is 3500 grams. The weight of the pail without any raspberries in it is 500 grams. If each raspberry weighs 5 grams, how many raspberries does Tony have in the pail?

If you're not sure how to solve the problem now, don't worry. You'll learn all the skills you need to solve the problem in this section. Give it a try now, or wait until the end of the section—it's up to you!

Lesson 6.2A: How to Solve One-Step Equations Involving Addition or Subtraction (+ or –)

Student Inquiry

This activity will help you get ready for, learn, and review the information in the upcoming lesson.

When you turn this page over, you will find a chart containing the inquiry outcomes for this lesson. You may be able to answer some of these questions already! Start by writing down your thoughts before the lesson.

When you finish the lesson, answer each question and give an example.

Student Inquiries	BEFORE THE LESSON What I already know about this question:	AFTER THE LESSON What I thought at the end: My final answer, and examples:
What is the inverse of addition?		answer
		example
What is the inverse of subtraction?		answer
		example
How do I solve a one-step equation like $x + 4 = 9$?		answer
		example
How do I check my answer to make sure it's correct?		answer
		example

Lesson 6.2A: How to Solve One-Step Equations Involving Addition or Subtraction (+ or –)

Thinking Space

Introduction

Imagine that you are sculpting a clay model of a duck. You start molding the clay into the body of the duck, adding two legs, a head, and a tail. Oh no! The duck's head is too big! You remove some clay from the duck's head… but now the clay duck falls backwards onto its tail. Then you remember what you are learning in algebra and it gives you an idea. If you remove clay from the head, you must also remove clay from the tail. Removing clay from the tail works; the duck stays balanced.

Let's explore what this example has to do with algebra. In this lesson, you'll learn how to work through the steps to solve equations that involve addition and subtraction. Good luck!

Explore Online

Looking for more practice or just want to play some fun games? If you have Internet access, go to the Math 7 website at:

http://www.openschool.bc.ca/courses/math/math7/mod6.html

Lesson 6.2A: Look for How to Solve One-Step Equations Involving Addition or Subtraction (+ or –) and check out some of the links!

Warm-up

Review addition and subtraction before you begin this lesson. Solving one-step equations in this lesson involves addition and subtraction.

Thinking Space

1. a. $3 + 6 =$ __________

   b. $3 + 11 =$ __________

   c. $4 +$ __________ $= 9$

   d. $14 +$ __________ $= 32$

   e. __________ $+ 24 = 83$

2. a. $7 - 3 =$ __________

   b. $11 - 7 =$ __________

   c. $17 -$ __________ $= 9$

   d. __________ $- 2 = 46$

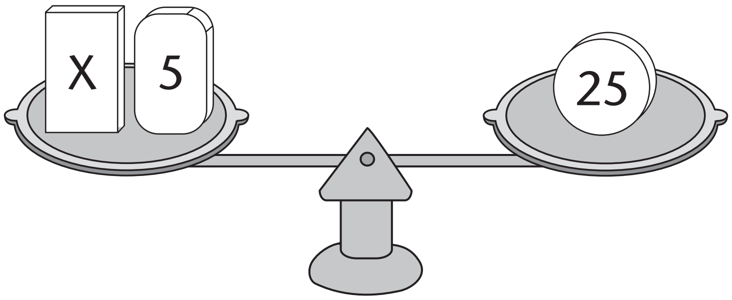
   e. $52 -$ __________ $= 19$

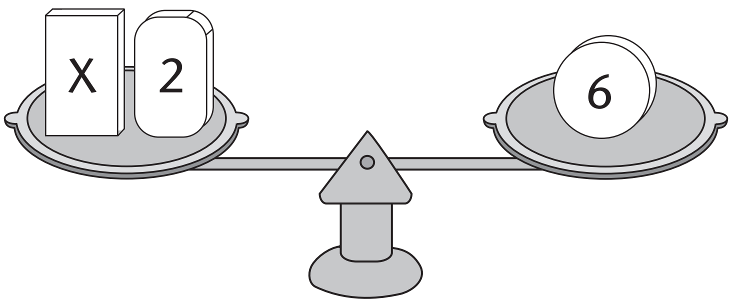
Turn to the Answer Key at the end of the Module and mark your answers.

Explore
Balancing the Scales

Thinking Space

Let's look at some scale balances and the equations that represent what we see.





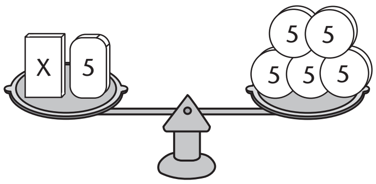
Can you think of a way to figure out what x represents in the above balance scales?

You must always keep the scales balanced. In other words:

> What you do to one side of the equation, you must do to the other side of the equation.

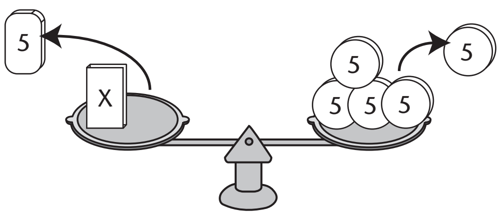
We need to **isolate** the variable so that we can determine what it equals (e.g., $x = 25$). The phrase <u>isolate the variable</u> means to get the variable by itself.

Let’s look at an example.



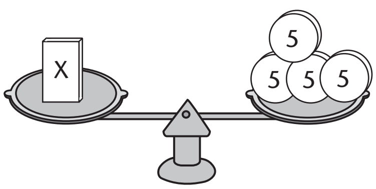
Write an equation that represents the balanced scale

$x + 5 = 25$



To get x by itself, remove 5. In the equation, remove 5 means subtract 5. Remember: keep the scale balanced!

$x + 5 = 25$
$(-5) \quad (-5)$



What are we left with? Write an equation that represents the balanced scale.

$x = 20$

Notice that the operation in our original equation was *addition*. To isolate the variable, we had to take away, or *subtract*. Addition and subtraction are *inverse* operations.

Addition undoes subtraction.

Subtraction undoes addition.

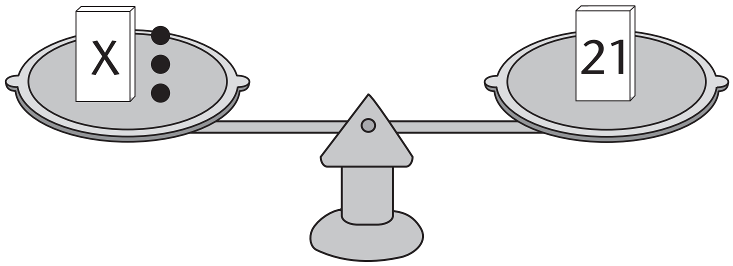
Now it’s your turn to practise balancing the scales.

Thinking Space

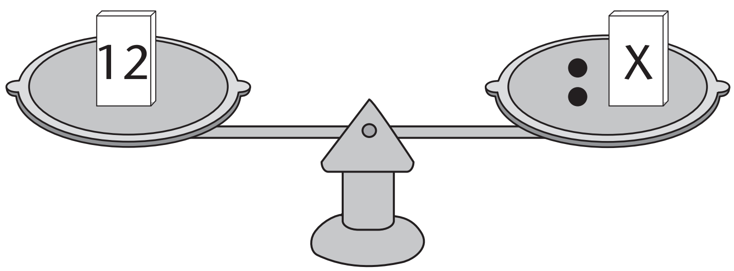
Practice 1

1. Write an equation to represent the following scale balances:

   a.

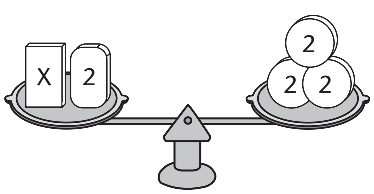


   b.

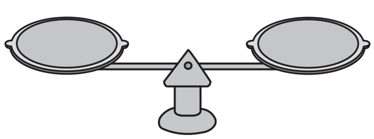


2. Complete the drawings and write the corresponding equations:

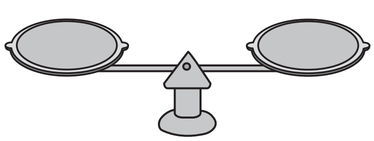
Scales | Equation



_____ + _____ = _____



_____ + _____ = _____
(   )   (   )



_____ + _____ = _____

Turn to the Answer Key at the end of the Module and mark your answers.

Explore

Solving One-Step Equations

Thinking Space

In this lesson, you will learn about solving one-step equations that are made up of one term added to or subtracted from another term. It is very similar to how you learned to balance the scales. Just remember:

- What you do to one side of the equation, you must do to the other side of the equation.
- The inverse of addition is subtraction, and the inverse of subtraction is addition.
- Our goal is to isolate the variable.

Here are some examples of one-step equations involving addition and subtraction:

$$x + 3 = 6$$

$$16 + x = 21$$

$$x + 7 = 15$$

$$x - 9 = 1$$

$$x - 4 = 3$$

Hmm... there aren't any coefficients in front of the variables. The only operations are + and −.

Solving One-Step Equations (Addition)

We don't always need to draw a scale to help us solve an equation. Let's look at some examples to explore how to solve one-step equations. These examples are all equations with addition.

Example A

What is the value of x in the equation below?

$$x + 2 = 6$$

Follow these steps to solve the equation:

Step 1: Write down the equation. $x + 2 = 6$

Step 2: You want to have the unknown variable isolated on one side of the equation. Use the inverse operation. $(-2)\ \ (-2)$

Step 3: Write down your answer. $x = 4$

Remember: You want to end up with x by itself (isolated).

Example B

What is the value of x in the equation below? $x + 2 = 9$

Step 1: Write down the equation. $x + 2 = 9$

Step 2: Perform the inverse operation to isolate x. $(-2)\ \ (-2)$

Step 3: Write down your answer. $x = 7$

Why do you think this is called a one-step equation?

Even though it looks like you're following three steps to solve the equation, there is one key step. The step that gives us our answer is the second one: performing the inverse operation.

In Example B, the equation is called a "one-step equation" because it requires the "one-step" of subtracting 2 from both sides to isolate x.

Thinking Space

If the equation adds, we subtract to solve it.

Adding zero doesn't change anything. $x + 0$ is the same as x.

I wonder why it's called a one-step equation? It looks like there are 3 steps!

Example C

Try filling in the blanks to solve for x.

Solve:

$$\begin{array}{rcl} 2 + c & = & 7 \\ (-\_\_) & & (-\_\_) \\ c & = & \_\_ \end{array}$$

Check your answer below:

$$\begin{array}{rcl} 2 + c & = & 7 \\ (-2) & & (-2) \\ c & = & 5 \end{array}$$

Solving One-Step Equations (Subtraction):

These examples will show you how to solve for the unknown variable when subtraction is used in the equation. Remember: the inverse of subtraction is addition.

Example D

What is the value of x?

$$x - 9 = 7$$

Follow these steps to solve the equation:

Step 1:	Write down the equation.	$x - 9 = 7$
Step 2:	You want to have the unknown variable isolated on one side of the equation. Use the inverse operation.	$(+\ 9)\ \ (+\ 9)$
Step 3:	Write down your answer.	$x = 16$

Remember: You want to end up with x by itself (isolated).

Thinking Space

!

Inverse operation means that if the equation adds, we subtract to solve it.

Subtracting zero doesn't change anything. x – 0 is the same as x.

Example E

Solve:

$$c - 8 = 20$$
$$(+\_\_)\quad(+\_\_)$$
$$c = \_\_$$

Thinking Space

Check your answer below:

$$c - 8 = 20$$
$$(+8)\quad(+8)$$
$$c = 28$$

Practice 2

Fill in the blanks in the equations below.

1. $c - 3 = 7$

   $(+\_\_\_) \quad (+\_\_\_)$

   $c = \_\_\_\_$

2. $x + 3 = 11$

   $(\_\_\_) \quad (\_\_\_)$

   $x = \_\_\_\_$

3. $p - 3 = 10$

   $(\_\_\_) \quad (\_\_\_)$

   $p = \_\_\_\_$

4. $m + 14 = 21$

   $(\_\_\_) \quad (\_\_\_)$

   $x = \_\_\_\_$

Turn to the Answer Key at the end of the Module and mark your answers.

Explore
Checking your Solutions

Thinking Space

"Solving an equation" means the same thing as "finding the solution that makes the equation true." To check your solution, you need to determine if both sides of the equation are balanced. You can do this by substituting your answer for the variable. If both sides of the equation are equal, the equation is "balanced."

Do you have any questions about what it means to solve an equation?

Helpful Hint: Here's a catchy way to remember the steps when you are checking your solution—"Solve, Substitute, SMILE". The smile comes when you find out your answer is indeed correct!

- You *solve* the equation so that x is isolated on one side of the equation.
- You *substitute* the value of x into the original equation.
- Then you can *smile* if both sides of the equal sign are the same!

Let's look at an example:

You have a number of blueberries in a bowl. You add four strawberries, to equal 19 pieces of fruit in the bowl. How many blueberries do you have?

Solve:

Let x = number of blueberries in one bowl.

Equation: $x + 4 = 19$

You need to take off 4 strawberries from both sides of the scale. Remember, what you do to one side of the scale you must do to the other to keep the scale balanced.

The equation is now:

$$x + 4 = 19$$
$$(-4) \quad (-4)$$

(Here we are applying the inverse of addition (subtraction) to solve our equation).

$$x = 15$$

If our calculations were correct, you should have 15 blueberries in your bowl.

Check your answer:

Substitute:

Check to see if $x = 15$

Equation:	$x + 4 = 19$
Substitute: 15 for the x	$15 + 4 = 19$
Are both sides balanced?	$19 = 19$

Both sides of the equation are balanced, so our solution is correct.

Smile! ☺

Looks like our calculations were correct. You have 15 blueberries in your bowl.

But what if we had made a mistake? How can checking our solution help us to find our mistakes? Let's see what would have happened if we had solved and got $x = 14$ as our answer:

Check to see if $x = 14$

Equation:	$x + 4 = 19$
Substitute 14 for the x:	$14 + 4 = 19$
Are both sides balanced?	$18 = 19$ oops! ☹

Both sides of the equation are not balanced, so my solution is incorrect. No smile.

When your check doesn't end in a smile, you know something's wrong. If you end up with an unbalanced statement like $18 = 19$, you know you've made a mistake along the way. You should always go back and try solving the equation again.

Try some practice activities to make sure you've got the hang of it. Solve, Substitute, and Smile!

Thinking Space

Remember, you need to Solve, Substitute, and Smile when solving one-step equations.

?

Why aren't the two sides of the equation balanced?

Practice 3

1. Evaluate if $x = 4$

   a. $x + 6$

   b. $9 - x$

   c. $32 - x$

2. Check to see if $x = 3$ for these equations:

   a. $4 + x = 7$

   b. $21 - x = 19$

   c. $x - 49 = 3$

3. Solve the following equations showing the steps of your work. Check your answer.

   a. $3 + x = 8$

   b. $q - 11 = 18$

c. $x - 10 = 2$

d. $3 + x = 19$

e. $w - 25 = 50$

f. $a - 8 = 8$

g. $x + 15 = 27$

h. $x - 47 = 62$

Turn to the Answer Key at the end of the Module and mark your answers.

Explore

Solving Word Problems

Thinking Space

You now have many of the skills needed to solve word problems involving one-step addition and subtraction equations. Let's practise some together!

A number increased by 2 is equal to six. What is the number?

Example

Create a variable (e.g. "x") to represent an unknown number. Let x = unknown number

Write out your equation. $x + 2 = 6$

Remember: Solve, Substitute, Smile!

Solve: Isolate the unknown variable on one side of the equation by using the inverse operation.

In this equation, 2 is added to the variable. To solve, you will subtract 2 on both sides of the equation.)

$$
\begin{aligned}
x + 2 &= 6 \\
(-2) \quad & \quad (-2) \\
x - 0 &= 4 \\
x &= 4
\end{aligned}
$$

Check your solution:

Substitute 4 for x in the original equation:

$$
\begin{aligned}
x + 2 &= 6 \\
(4) + 2 &= 6 \\
6 &= 6
\end{aligned}
$$

Yes, the solution is correct! Smile!

Don't forget to answer the problem.

The number is 4.

Thinking Space

Let's try another example:

Zachary has some hockey cards. He gives three of them to a friend and has 11 cards left. How many hockey cards did Zachary have to start with before he gave 3 cards away?

Example

Create a variable (e.g. "x") to represent an unknown number.

Let x = unknown number of hockey cards

Write out your equation.

$x - 3 = 11$

Solve: Isolate the unknown variable on one side of the equation, using the inverse operation of subtraction—addition.

Because 3 is subtracted from the variable, you must add 3 to bothsides of the equation to maintain balance.

$$x - 3 = 11$$
$$(+\ 3) \qquad (+\ 3)$$
$$x - 0 = 14$$
$$x = 14$$

Check your solution.

Substitute 14 for x in the original equation:

$$x - 3 = 11$$
$$(14) - 3 = 11$$
$$11 = 11$$

Yes, the answer is correct. Smile!

Make sure to answer the problem.

Zack had 14 hockey cards to start with before he gave 3 cards away.

Practice 4

1. Express the following statements as equations and solve. Check your answers.
   Let x = unknown number

   a. 6 less than a number is 8.

   b. A number increased by 3 equals 12.

   c. Four plus a number is 25.

   d. A number increased by 11 gives 19.

2. Alex has some hockey cards and gives 7 cards away. He now has 31 hockey cards left. How many cards did he start with?

Turn to the Answer Key at the end of the Module and mark your answers.

Lesson 6.2B: Solving One-Step Equations Involving Multiplication or Division (× or ÷)

Thinking Space

Introduction

Here's an algebra puzzle for you:

- Pick a number.
- Add 4 to the number.
- Then multiply by 2.
- Subtract 6.
- Divide it by 2.
- Now subtract 1 to get your answer.

What did you get? Your answer should be the same number that you started with. This will work for any number you choose. Try different numbers and see what happens.

To find out if the puzzle works, you can substitute numbers for the variable and see if the result is always the same. Checking your solutions of equation problems works the same way. Remember—Solve, Substitute, Smile!

To solve this puzzle, you have to use all four operations: +, –, ×, ÷. In the last lesson, you learned how to keep a scale or one-step equation balanced by adding or subtracting. You can also keep a scale or one-step equation balanced by multiplying or dividing.

In this lesson, you will be learning how to solve, substitute, and smile using one-step equations that involve multiplication or division (× or ÷).

Warm-up

Thinking Space

It will help you to review some vocabulary as well as multiplication and division before you begin this lesson. Solving one-step equations in this lesson will involve multiplication and division.

Remember: A term can be made up of a number and variable, multiplied or divided by each other. For example, $x \div 3$ is a term. $3x$ is also a term.

Multiplication

Sometimes we write multiplication using brackets.

For example:

3(6) is a term that means the same as 3×6.

3(6) and 3×6 both equal 18

Note: If you are multiplying more than 2 numbers together, proceed in steps by multiplying two numbers at a time.

For example: (4)(2)(15) is the same as $4 \times 2 \times 15$.

Here there are 3 numbers to multiply, so start by multiplying the first two numbers. Then multiply that answer by the third number.

$$
\begin{aligned}
&(4)\,(2)\,(15) \\
&= (8)(15) \\
&= 120
\end{aligned}
$$

Thinking Space

Division

When we divide, we're splitting our starting number into equal groups, and counting the number of groups we can make. The answer in a division question is called the "quotient."

Example:

Marc has 12 cookies to divide among himself and three friends. How many cookies will each person get?

Answer: Each person gets three cookies.

Try these questions to get warmed up!

1. Identify the variable, coefficient, and constant term in the following examples:

	Variable	Coefficient	Constant Term
a. 3			
b. $3a$			
c. $2n + 3$			
d. ab			
e. $r \div 2$			
f. $x \div 3$			
g. x			

2. Fill in the missing numbers without using a calculator.

   a. $7 \times 3 = \_\_\_\_\_$

   b. $6 \times 4 = \_\_\_\_\_$

   c. $3 \times \_\_\_\_ = 24$

   d. $15 \times \_\_\_\_ = 45$

   e. $18 \times 25 =$

   f. $\_\_\_ \times 9 = 72$

   g. $8 \times \_\_\_ = 56$

   h. $2 \times \_\_\_\_ = 22$

   i. $5(6) =$

   j. $5(3)(2) =$

   k. $16(4)(5) =$

   l. $(3)(7)(5) =$

3. Fill in the missing numbers without using a calculator.

   a. $15 \div 5 =$

   b. $36 \div \_\_\_ = 6$

   c. $24 \div 2 =$

   d. $125 \div 5 =$

   e. $56 \div \_\_\_ = 7$

   f. $49 \div 7 =$

   g. $18 \div 3 =$

   h. $32 \div 4 =$

   i. $36 \div \_\_\_ = 9$

Turn to the Answer Key at the end of the Module and mark your answers.

Thinking Space

Explore

We already looked at one-step equations with addition or subtraction, but one-step equations can sometimes involve multiplication or division operations instead.

For example, $2x = 6$ and $x \div 2 = 5$ are both one-step equations.

You'll notice that on one side of each equation there is a single term: an unknown number written as a variable that is either multiplied or divided by a number. On the other side of each equation is a single, constant term.

To solve these kinds of one step equations, we undo the operation.

What do you think it means to "undo" the operation?

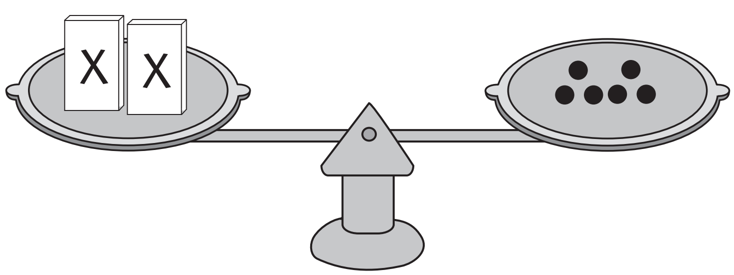
We undo multiplicaton by dividing.

We undo division by multiplying.

Solving One-Step Equations (Multiplication)

Let's work through some one-step equations involving multiplication. You will need to use division (the inverse operation of multiplication) to solve these problems.

Example A



How can you figure out the value of each block on the scale?

Let x = one block.

There are 2 blocks, so you write $2x$ as the total number of blocks.
x = the unknown number of counters in one block.

Thinking Space

Remember our divisibility rules? You can never divide by zero!

How are these one-step equations similar to one-step equations with + and −?

Now, write an equation to represent the balance using $2x$ for the blocks. There are six counters on the right hand side of the scale, so our equation should look like this:

$$2x = 6$$

Okay, let's solve for x.

Remember: WHAT YOU DO TO ONE SIDE, YOU MUST DO TO THE OTHER SIDE.

We are multiplying by 2. We can undo that by dividing by 2.

Your equation should look like this:

$$\begin{array}{c} 2x = 6 \\ (\div 2) \quad (\div 2) \\ 1x = 3 \end{array}$$

The value of one block is 3. So $x = 3$.

Note: sometimes when we divide both sides of the equation, we write it in a different way. Look at the two ways of showing your work: they both mean the same thing.

$$\begin{array}{c} 2x = 6 \\ (\div 2) \quad (\div 2) \\ x = 3 \end{array}$$

OR

$$2x = 6$$
$$\frac{2x}{2} = \frac{6}{2}$$
$$x = 3$$

Thinking Space

Remember, we want to isolate the variable.

Remember, dividing is the inverse of multiplication.

1x is the same as x. You don't need to include the coefficient 1 in front of the x for 1x.

Steps to follow when solving one-term equations involving multiplication:

Step 1: Choose a variable for the quantity that you are trying to find.

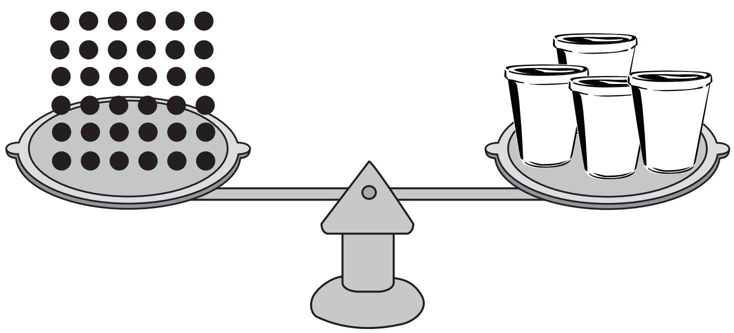
Step 2: Write down the equation that represents the problem.

Step 3: Perform the inverse operation.

Remember: WHAT YOU DO TO ONE SIDE, YOU MUST DO TO THE OTHER SIDE.

Step 4: Write down your answer.

Example B



Solve:

Step 1: Choose a variable.
Let x = unknown quantity of counters in a cup.

Step 2: Write down the equation that represents the problem. $36 = 4x$

Step 3: Solve. We can undo multiplying with dividing. $(\div 4) \quad (\div 4)$

Divide both sides by 4. $9 = 1x$

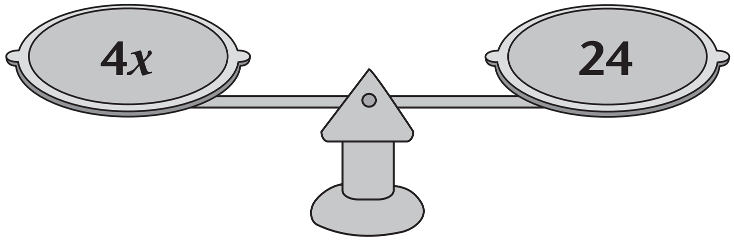
Step 4: Write down your answer: $x = 9$

1 cup has 9 counters inside it.

Thinking Space

The inverse of multiplication is division.

Example C



Write an equation for the balance scale:

Using the steps above, solve for x:

Check to see that your answer looks like the one below. When you are ready, try the practice questions.

Answer:

$$4x = 24$$

$$(\div 4) \quad (\div 4)$$

$$x = 6$$

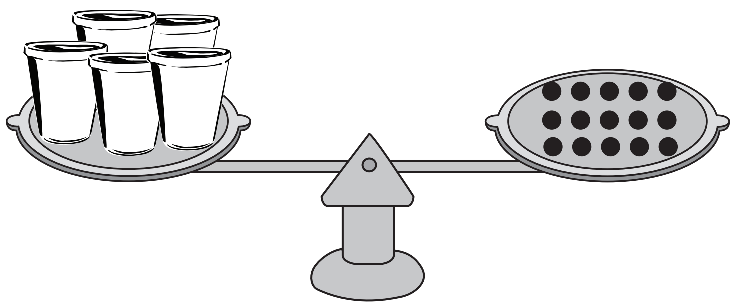
Thinking Space

Remember, the inverse of multiplication is division, and what you do to one side of the equation, you must do to the other.

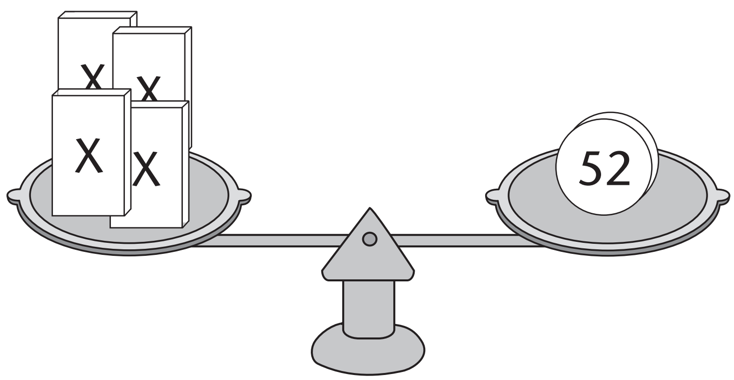
Practice 1

1. Solve the following one-step equations involving multiplication:

   a. If each cup has the same number of counters, how many counters are in each cup?



   b. What is the value of one block?



2. Fill in the blanks.

   a.

$$3x = 24$$
$$3x = 24$$
$$(\div \_\_) \quad (\div \_\_)$$
$$x = \_\_\_\_$$

   b.

$$2x = 14$$
$$2x = 14$$
$$(\div 2) \quad (\div \_\_)$$
$$x = \_\_\_\_$$

c.

$$4y = 160$$

$$\begin{array}{cc} 4y & = 160 \\ (\div 4) & (\div \_\_) \end{array}$$

$$y = \_\_\_\_$$

d.

$$5x = 50$$

$$\begin{array}{cc} 5x & = 50 \\ (\div \_\_) & (\div 5) \end{array}$$

$$x = \_\_\_\_$$

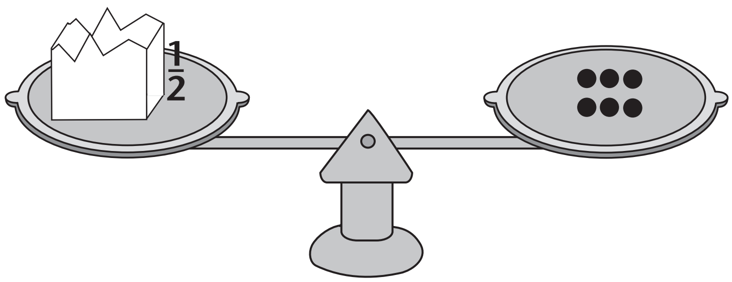
Turn to the Answer Key at the end of the Module and mark your answers.

Explore
Solving Equations (Division)

Thinking Space

To solve one-term equations involving division, you use the inverse operation—multiplication.

Example D



If half a box balances equally with 6 widgets (half a box holds 6 widgets), how many will fit in a full box?

To solve this problem, let x represent the box.

$$\frac{1}{2}x = 6$$

Multiply both sides by 2.

$$2\left(\frac{1}{2}x\right) = 2(6)$$
$$\frac{2}{2}x = 12$$
$$x = 12$$

Twelve widgets fill a box.

Steps to follow when solving one-step equations involving division:

Step 1: Choose a variable for the quantity that you are trying to find.

Step 2: Write down the equation that represents the problem.

Step 3: Perform the inverse operation. The inverse of division is multiplication.

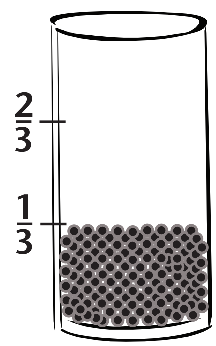
> Remember: WHAT YOU DO TO ONE SIDE, YOU MUST DO TO THE OTHER SIDE.

Step 4: Write down your answer. Remember, the coefficient of a single variable x is 1, but you don't write the 1.
For example, for $1x$, you just write x.

Thinking Space

Example E

Kayla has collected 121 pennies, which is one-third of the pennies needed to fill her collection jar. How many pennies will she have when the jar is full?



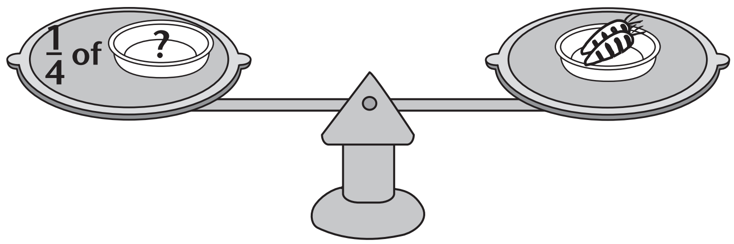
Step 1:	Let x = quantity that you are trying to solve.	Let x = total number of pennies.
Step 2:	Write down the equation that represents the problem.	$\frac{1}{3}x = 121$
Step 3:	Multiply both sides by 3. The inverse of dividing by 3 is multiplying by 3.	$(\times 3) \quad (\times 3)$
Step 4:	Write down your answer.	$x = 363$
	The collection jar can hold 363 pennies.	

What you do to one side, you must do to the other.

Example F

Thinking Space

Sam is eating some carrots out of a dish. He sees that he has eaten $\frac{3}{4}$ of the carrots, and has only $\frac{1}{4}$ of the carrots left in the bowl. If there are 2 carrots left, how many carrots were in the bowl when he started?



Write down an equation to represent the scale:

Let x = total carrots.

Equation: $x \div 4 = 2$

$x \div 4 = 2$ (Multiply both sides by 4, which is
(× 4) (× 4) the inverse of dividing by 4.)

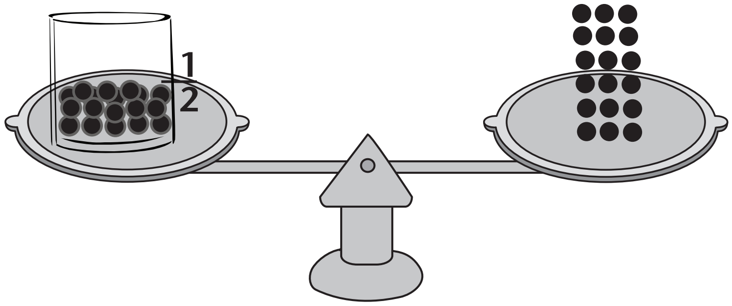
$x = 8$

There were 8 carrots in the bowl.

Practice 2

1. Solve the following one-term equations involving division:

   a.



   How many counters fill one whole cup?

   b. $\frac{1}{4}$ piece of paper = 42 circles of paper
   How many paper circles can you make from 1 piece of paper?

2. Fill in the blanks.

   a. $\frac{n}{3} = 12$

   $(\times 3)\frac{n}{3} = 12(\times 3)$

   $n =$ ___

   b. $\frac{n}{4} = 72$

   $(\times 4)\frac{n}{4} = 72(\times 4)$

   $n =$ ___

   c. $\frac{n}{5} = 35$

   $(\times 5)\frac{n}{5} = 35(\times \_\_\_)$

   $n =$ ___

   d. $\frac{n}{8} = 56$

   $(\times 8)\frac{n}{8} = 56(\times \_\_\_)$

   $n =$ ___

   e. $\frac{n}{6} = 36$

   $(\times \_\_\_)\frac{n}{6} = 36(\times \_\_\_)$

   $n =$ ___

3. Solve for the variable.

   a. $5r = 15$

   b. $7q = 42$

   c. $x \div 3 = 15$

   d. $y \div 2 = 14$

   e. $3a = 0$

Turn to the Answer Key at the end of the Module and mark your answers.

Explore

Check your Answers: Solve, Substitute, Smile!

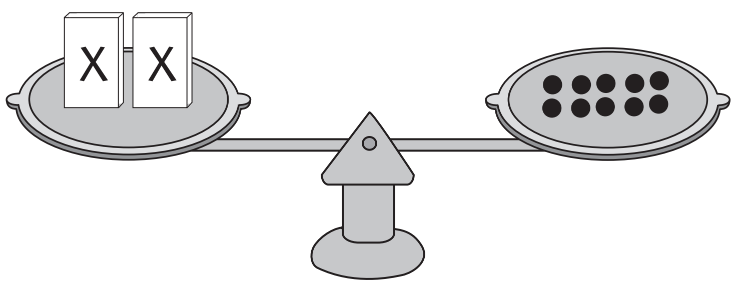
Thinking Space

In the last lesson, you learned how to solve, substitute, and smile when solving one-step equations (+ and –). You can use "Solve, Substitute, Smile" when you are solving one-step equations (× and ÷) too!

Remember to follow the steps from the last lesson when you check your solution: "Solve, Substitute, SMILE." The smile comes when you find out that your answer is correct.

- You *solve* the equation so that x is isolated on one side of the equation.
- You *substitute* the value of x into the original equation.
- Then you can *smile* if both sides of the equal sign are the same!

Example G



$$\begin{aligned} 2x &= 10 \\ \frac{2x}{2} &= \frac{10}{2} \\ x &= 5 \end{aligned}$$ ☺

We apply the inverse of multiplication (division) to solve this equation.

Check your solution:

Sometimes, you can check your answer by inspection:

Use real objects to verify your results.

Thinking Space

Using two cups and ten marbles, divide the marbles evenly between the cups. How many marbles do you have in each cup? You should have 5 marbles in each cup.

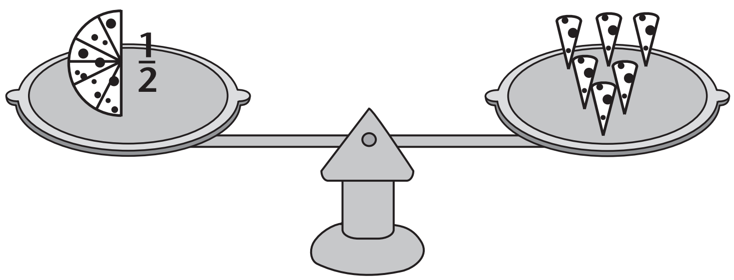
Otherwise, **substitute** the answer for the variable in the original equation.

$$\begin{aligned} 2x &= 10 \\ 2(5) &= 10 \\ 10 &= 10 \end{aligned}$$ ☺

Remember to answer the question.

The value of 1 block is equal to 5 counters.

Example H



How many pieces of pizza are there in a whole pizza?

Let x = 1 pizza.

$$\begin{aligned} \frac{1}{2}x &= 6 \\ (\times 2)\frac{1}{2}x &= 6(\times 2) \\ \frac{2x}{2} &= 12 \\ x &= 12 \end{aligned}$$

You are dividing by 2 so multiply everything by 2.

Check your solution:

Sometimes, you can check your answer by inspection:

Use real objects to verify your results.

Line up 6 blocks.

Line up another row of 6 below this row.

Count up how many blocks you have in total.

You should have 12.

Or, **substitute** the answer for the variable in the original equation.

$$\frac{1}{2}x = 6$$
$$\frac{1}{2}(12) = 6$$
$$6 = 6 \quad ☺$$

Answer the question:

There are 12 pieces in one whole pizza.

Thinking Space

Practice 3

1. Evaluate if $x = 4$

   a. $5x$

   b. $20 \div x$

   c. $x \div 4$

   d. $5x - 2x$

2. Check to see if $x = 3$ for these equations:

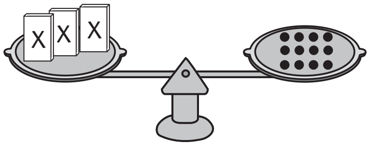
   a. $6x = 18$

   b. $21x = 64$

   c. $x \div 3 = 1$

   d. $54 \div x = 18$

3. How many counters are in each block?



a. Write down an equation to represent the scale.

b. Solve the equation.

c. Check your answer.

4. Fill in the blanks in the following equations and check your solution.

a.
$$\begin{aligned} 4a &= 32 \\ 4a &= 32 \\ (\div 4) &\quad (\div 4) \\ a &= \_\_\_ \end{aligned}$$

b.
$$\begin{aligned} \frac{1}{3}a &= 21 \\ (\times 3)\frac{1}{3}a &= 21(\times \_\_) \\ a &= \_\_\_ \end{aligned}$$

c.
$$\begin{aligned} 8x &= 32 \\ 8x &= 32 \\ (\div \_\_) &\quad (\div \_\_) \\ x &= \_\_\_ \end{aligned}$$

d.
$$\begin{aligned} \frac{1}{2}b &= 6 \\ (\times \_\_)\frac{1}{2}b &= 6(\times \_\_) \\ b &= \_\_\_ \end{aligned}$$

5. Evaluate if d = 4

   a. $3d$

   b. $8 \div d$

   c. $21d$

   d. $d \div 2$

Turn to the Answer Key at the end of the Module and mark your answers.

Lesson 6.2C: Solving Two-Step Equations

Student Inquiry

This activity will help you get ready for, learn, and review the information in the upcoming lesson.

When you turn this page over, you will find a chart containing the inquiry outcomes for this lesson. You may be able to answer some of these questions already! Start by writing down your thoughts before the lesson.

When you finish the lesson, answer each question and give an example.

Student Inquiries	BEFORE THE LESSON	AFTER THE LESSON
	What I already know about this question:	What I thought at the end: My final answer, and examples:
What are terms in an expression?		answer
		example
How do I solve a two-step equation like $2x + 5 = 9$?		answer
		example
How do I solve a work problem using algebra?		answer
		example

Lesson 6.2C: Solving Two-Step Equations

Thinking Space

Introduction

Imagine you are weighing some apples and oranges at a grocery store. You place one apple on a scale. Forgetting to look at the scale to see how much one apple weighs, you add four more apples. Now, you add 8 oranges and the scale weighs 3 kg. You're curious to see how much just one apple weighs. What can you do to figure out how much just one apple weighs?

?

Well, you can remove the oranges that you added to the scale. Then you can divide the weight of five apples by five. Or, you could then remove four of the apples to leave one apple on the scale. You could then read the weight of just one apple on the scale.

In this lesson, you will learn how to solve two-step equations that involve more than one operation. It's just like adding and removing objects from a balance scale. Good luck!

Explore Online

Looking for more practice or just want to play some fun games?
If you have Internet access, go to the Math 7 website at:

http://www.openschool.bc.ca/courses/math/math7/mod6.html

Lesson 6.2C: Solving Two-Step Equations and check out some of the links!

Warm-up

You learned about terms and coefficients in previous lessons.

This expression has two terms:

$$3x + 9$$

The terms are $3x$ and 9.

The coefficient of x is 3.

Get ready for this lesson about solving two-step equations with these questions about terms and coefficients.

1. Underline the term with the variable in it.

   Example: $\underline{3x} + 9$

   a. $2x + 7$

   b. $b - 3$

   c. $4 + 6q$

   d. $37 + 86t$

   e. $\frac{1}{2}y - 1$

   f. $7 + 2x$

   g. $-13 + 9q$

2. Here are those same expressions again. This time, give the coefficient of each variable.

   Example: $3x + 9$ Coefficient is $\underline{\ 3\ }$

   a. $2x + 7$ ______

b. $b - 3$ ______

c. $4 + 6q$ ______

d. $37 + 86t$ ______

e. $\frac{1}{2}y - 1$ ______

f. $7 + 2x$ ______

g. $-13 + 9q$ ______

Turn to the Answer Key at the end of the Module and mark your answers.

Explore

You have learned how to solve one-step equations involving addition, subtraction, multiplication and division operations.

You are now going to learn how to solve two-step equations involving both: multiplication or division *and* addition or subtraction.

Some examples of two-step equations are shown below:

$$2x + 7 = 9$$

$$3x - 2 = 7$$

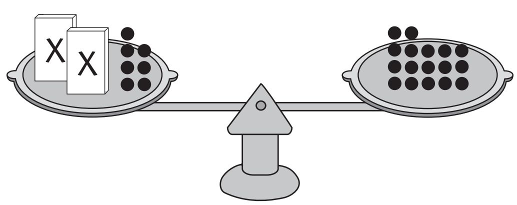
$$\frac{1}{2}x + 3 = 8$$

Why do you think these equations are called two-step equations?

There are two operations in each of these equations, so you solve these equations using two steps.

Let's find out how.

Solving Two-Step Equations Using a Balance Scale



What do you think is the first step in figuring out the value of each block?

You want to isolate a single block on one side of the scale, so get rid of the counters on the left side first.

Thinking Space

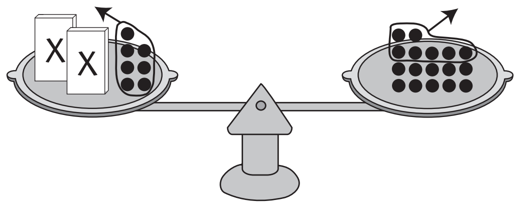
These are the kinds of equations I already know how to solve:

$x + 3 = 6$
$9 - x = 5$
$2x = 10$
$x \div 2 = 5$

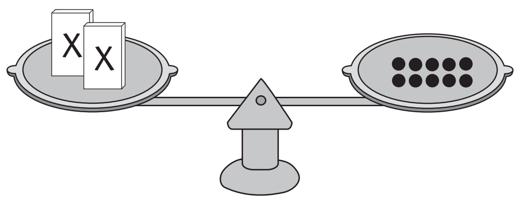
Thinking Space

Step 1: Remove the 7 counters from the left side of the balance.

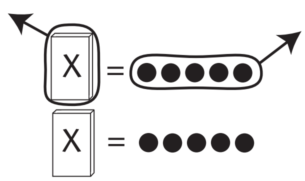
What you do to one side, you must do to the other. So, remove 7 counters from the right side.



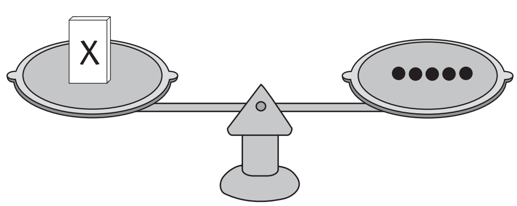
The balance now looks like this:



Step 2: Think about how many counters each block represents.



Since 2 blocks balance 10 counters, each block must represent 5 counters. Remember that you have to keep the scale balanced, but you want to isolate one block.

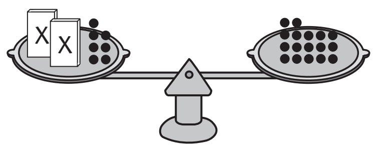
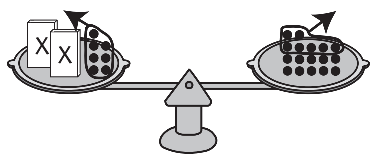
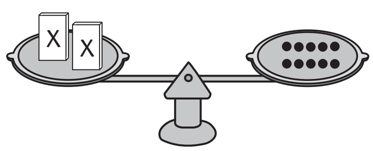
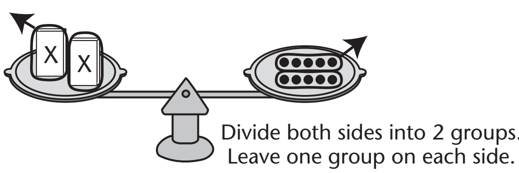
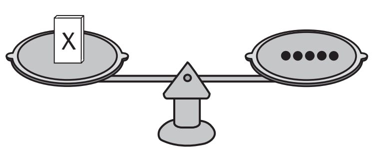


Step 3: Answer the question:

The value of 1 block is equal to 5 counters.

Let's see if we can write equations to go with the scale pictures in this example.

Thinking Space

	$2x + 7 = 17$
	$2x + 7 = 17$ $\quad (-7) \quad (-7)$
	$2x = 10$
	$\frac{2x}{2} = \frac{10}{2}$
	$x = 5$

Practice 1

1. Fill in the blanks using these words:

subtract	substituting
division	isolate
inverse	solution
divide	other
equation	quotient
product	

a. An algebraic _________ is a complete sentence that contains an equal sign.

b. To check if your answer is correct, you verify your ___________.

c. Addition and subtraction are ____________ operations.

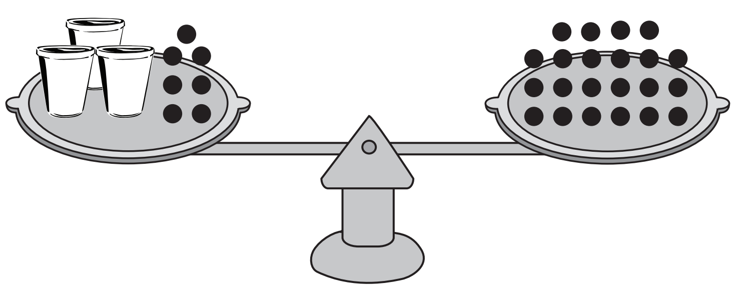
d. Multiplication and ____________ are inverse operations.

e. It is possible to verify your solution by ______________ the answer for the variable in the original equation.

f. What you do to one side of the equation, you must do to the ____________ side of the equation.

g. To solve an equation, you ______________ the variable on one side of the equation.

2. How many counters are in each cup?



Turn to the Answer Key at the end of the Module and mark your answers.

Explore

Solving Two-Step Equations

The examples we looked at so far illustrated the process behind solving two-step equations. Linking pictures to the algebra is a useful strategy to approach equation-solving. Let's look a little closer at the algebra now.

Let's solve

$$3x + 4 = 10$$

First, isolate the term with the variable in it.

You practised finding this term in the Warm-up activity.

$$3x + 4 = 10$$

In this equation, "$3x$" is the term with the variable in it. We need to isolate that term. We need to get that term by itself.

How can we get rid of "+ 4" ?

We need to subtract 4. Remember: What we do to one side of the equation, we must do to the other side.

$$\begin{array}{c} 3x + 4 = 10 \\ \quad(-4) \quad\; (-4) \\ 3x = 6 \end{array}$$

Ta da! The term with the variable is by itself.

Second, isolate the variable.

Do this by getting rid of the coefficient. You practised finding coefficients in the Warm-up.

$$3x = 6$$

The coefficient of x is "3". It is telling us to multiply by 3.

How do we get rid of "multiply by 3"?

We need to divide by 3. What we do to one side, we must do to the other side.

Thinking Space

Remember, you can draw a picture ANY time to help you understand a problem or equation.

!

Isolate means 'get it by itself.'.

$$\frac{3x}{3} = \frac{6}{3}$$
$$x = 2$$

Have we solved the equation? We need to check our answer to be sure.

Check by substitution:

$$3x + 4 = 10$$
$$3(2) + 4 = 10$$
$$6 + 4 = 10$$
$$10 = 10 \quad ☺$$

Try, another example.

$$5x - 4 = 16$$

First, isolate the term with the variable in it.

The term with the variable is "4x". We need to get rid of "– 4."

$$5x - 4 = 16$$
$$(-4) \quad (-4)$$
$$5x = 20$$

Second, isolate the variable.

The variable is "x". We need to get rid of the coefficient "5."

$$\frac{5x}{5} = \frac{20}{5}$$
$$x = 4$$

Now we check our answer.

$$5x - 4 = 16$$
$$5(4) - 4 = 16$$
$$20 - 4 = 16$$
$$16 = 16 \quad ☺$$

Thinking Space

It's like the 3 is stuck to the x. The 5 is only attached with a (–). We want the x alone, but we can't get rid of the 3 until we remove the –5 that's hanging on the outside!

We'll do one more together.

$$\frac{x}{2} - 5 = 8$$

First, isolate the term with the variable in it.

The term with the variable is "$\frac{x}{2}$." We need to get rid of "– 5."

$$\frac{x}{2} - 5 = 8$$
$$(+5) \quad (+5)$$
$$\frac{x}{2} = 13$$

Second, isolate the variable.

In the equation, we are dividing x by 2. We get rid of that by doing the inverse. We need to multiply by 2.

$$2\left(\frac{x}{2}\right) = (2)13$$
$$x = 26$$

Check the answer:

$$\frac{x}{2} - 5 = 8$$
$$\frac{26}{2} - 5 = 8$$
$$13 - 5 = 8$$

You're ready to do some questions on your own. If you need help, look back at these examples.

Thinking Space

Practice 2

Fill in the blanks to solve the following equations:

1. 2x – 5 = 7

   Solve:

   Step 1: $2x - 5 = 7$

   $+\_\_\_\_ \quad + \_\_\_\_\_$

   $2x = \_\_\_\_\_\_$

   Step 2: $2x = 12$

   $\div\_\_\_ \quad \div\_\_\_$

   $x = \_\_\_\_\_$

   Check your answer:

   $2x - 5 = 7$

   $2(\_\_\_\_) - 5 = 7$

   $\_\_\_ - 5 = 7$

   $\_\_\_ = 7$

2. $4y + 6 = 18$

   Solve:

   Step 1:

   $4y + 6 = 18$

   $(-\_\_\_)\ (-\_\_\_)$

   $4y = \_\_\_\_\_\_$

   Step 2:

   $4y = 12$

   $\div\_\_\_ \quad \div\_\_\_$

   $y = \_\_\_\_\_$

   Check your answer. Did you smile?

3. $\frac{y}{4} - 2 = 14$

Solve:

$$\frac{y}{4} - 2 = 14$$
$$(+ \_\_) \quad (+ \_\_\_\_)$$
$$\frac{y}{4} = \_\_\_\_\_\_$$
$$\frac{y}{4} = \_\_\_\_\_$$
$$(\text{x } 4) \quad (\text{x } 4)$$
$$y = \_\_\_\_\_$$

Substitute:

Check your answer. Did you smile?

4. $\frac{x}{3} + 6 = 10$

Solve:

$$\frac{x}{3} + 6 = 10$$

Step 1:

$$\frac{x}{3} + 6 = 10$$
$$(- \_\_) \quad (- \_\_)$$
$$\frac{x}{3} = \_\_\_\_\_\_$$

Step 2:

$$\frac{x}{3} + 6 = 10$$
$$(\text{x } 3) \quad (\text{x } 3)$$
$$\frac{x}{3} = \_\_\_\_\_\_$$

Substitute.

Check your answer.

Turn to the Answer Key at the end of the Module and mark your answers.

Explore
Solving a Word Problem

You already have all the skills you need to solve word problems.

- Translate an English sentence into an algebraic equation.
- Solve an algebraic equation.

Now you need to put all of those skills together.

Example 1:

The product of an unknown number and two, plus seven, is fifteen.

What is the number?

		Example
Step 1:	Highlight or underline information that is needed to solve the problem.	product of a number and two plus seven is fifteen
Step 2:	Let the unknown number be represented by a variable such as n	Let n = unknown variable.
Step 3:	Translate the word problem into an algebraic equation.	product of a number and two is written as ($2n$) plus seven is written as (+ 7) is fifteen is written as (=15) The equation is: $2n + 7 = 15$.
Step 4:	Solve by isolating the n on one side of the equation.	$2n + 7 = 15$ $(-7) \quad (-7)$ $2n = 8$ $(\div 2) \quad (\div 2)$ $n = 4$

Thinking Space

Do you remember how to translate words into algebra symbols?

Review Section 6.1B to review terms and their meanings.

Step 5: Check your answer.

$$2x + 7 = 15$$
$$2(4) + 7 = 15$$
$$8 + 7 = 15$$
$$15 = 15$$

Smile!

Step 6: Answer the problem. The unknown number is 15.

Thinking Space

You need to check if the solution makes the equation true.

Example 2:

Scott collects sea shells and rocks. He has 37 rocks in total. The number of rocks is five more than four times the number of sea shells. How many sea shells does Scott have in his collection?

	Example
Step 1: Highlight or underline information that is needed to solve the problem.	37 rocks in total number of rocks (is) (5 more) than (4 times the number of sea shells) I want to find out how many sea shells are in Scott's collection.
Step 2: Let the unknown number be represented by a variable such as n	Let x = the number of sea shells.
Step 3: Translate the word problem into an algebraic equation.	I know: "Is" means "equal to." "Five more" means "+ 5." "Four times the number of seashells" means "4 × the number of seashells." $4x + 5 = 37$

Thinking Space

Step 4:	Solve by isolating the x on one side of the equation.	$4x + 5 = 37$ $(-5) \quad (-5)$ $4x = 32$ $(\div 4) \quad (\div 4)$ $x = 8$
Step 5:	Check your answer.	$4x + 5 = 37$ $4(8) + 5 = 15$ $32 + 5 = 37$ $37 = 37$ Smile!
Step 6:	Answer the problem.	Scott has 8 sea shells in his collection.

Practice 3

1. Solve the following word problems using these steps:

   Step 1: Write a let statement to name the variable that represents the unknown number.

   Step 2: Translate the word problem into an algebraic equation.

   Step 3: Solve for the variable by isolating a single variable on one side. Show your work.

   Step 4: Verify your solution.

   a. The sum of twice a number and eight is thirty. What is the number?

   b. The product of 5 and a number less 4 is 11. What is the number?

   c. A number divided by three plus 6 equals 10.

2. Solve for the variable and verify the solution.

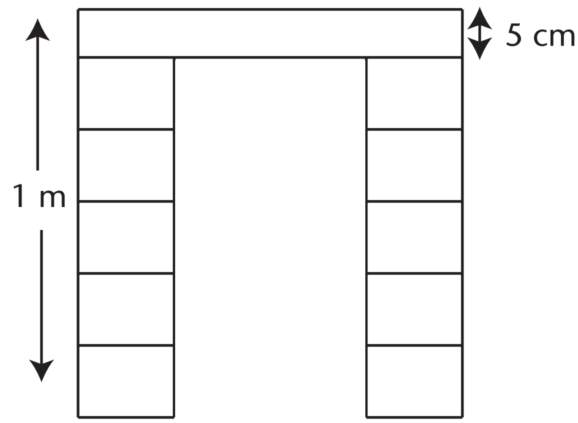
   a. $2x + 4 = 10$

   b. $3x - 5 = 4$

   c. $\frac{1}{2}x + 4 = 10$

   d. $\frac{1}{3}x - 2 = 4$

3. A platform 5 cm thick is supported by concrete blocks of equal thickness as shown. The height is 1m from the floor to the top of the platform. How thick is each concrete block?



4. Here's a challenge question for you. Try your best; if you get stuck. look at the solution in the answer key.

   Stephanie has a collection of leaves and pine cones. She has 46 pine cones in total. The number of pine cones is 5 less than 3 times the number of leaves. How many leaves does Stephanie have in her collection?

Turn to the Answer Key at the end of the Module and mark your answers.

Section Summary

You now have the skills to solve the Section Challenge: How many raspberries did you pick?

First, review the summary below.

One-step equations involve using one of the following: addition, subtraction, multiplication, or division operations.

Two-step equations involve using both (addition or subtraction) and (multiplication or division) operations.

To solve equations, you need to apply inverse operations to "undo" the equation .

- The inverse of addition is subtraction.
- The inverse of subtraction is addition.
- The inverse of multiplying is dividing.
- The inverse of dividing is multiplying.

Make sure you keep the equation balanced:

What you do to one side of the equation, you must do to the other side.

To determine the value of the variable, you perform the following steps: solve, substitute, smile!

- You **solve** the equation so that x is isolated on one side of the equation.
- You **substitute** your answer for x into the original equation to make sure it balances.
- Then you can **smile** if both sides of the equal sign are the same!

Problem Solve Using Algebra:

Solve the word problems using these steps:

Step 1: Write a let statement to name the variable that represents the unknown number.

Step 2: Translate the word problem into an algebraic equation.

Step 3: Solve for the variable by isolating a single variable on one side. Show your work.

Step 4: Verify your solution.

Section Challenge

Now it's time to try the Section Challenge! You can use the problem solving steps on the previous page to help you.

The question is, how many raspberries did you pick?

Tony has picked raspberries and put them into a pail. The weight of the pail with raspberries is 3500 grams. The weight of the pail without any raspberries in it is 500 grams. If each raspberry weighs 5 grams, how many raspberries does Tony have in the pail?

Answer Key Table of Contents

Answer to Pretest 6.1

1. a. Equal $7 + 9 = 16$

   b. Equal $3 + 4 = 7$

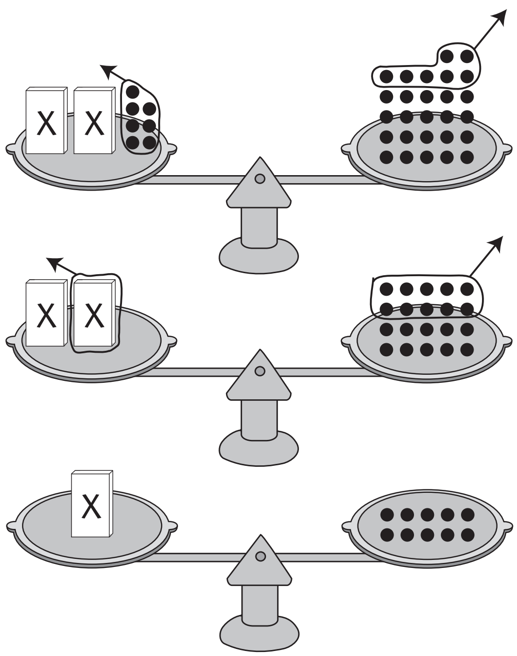
   c. Not Equal $16 + 16 = 32$

   d. Equal $4(5 – 2) = 4(5) = 12$

   e. Not Equal $10 – 2 \times 4 = 10 – 8 = 2$

2. a. 6 counters

   b.



   7 counters need to be removed

   1 block equals 10 counters

3. a. expression

   b. equation

   c. equation

   d. equation

   e. expression

4. b. The sum of six and a number is eleven. ($6 + x = 11$)

   c. Seven less than a number is five. ($n - 7 = 5$)

   a. The product of five and a number is thirty-five. ($5x = 35$)

   e. The sum of a number and 2 is eight. ($w + 2 = 8$)

   d. One half a number is twelve. ($\frac{1}{2}h = 12$)

5. b. $x - 5 = 3$ (A number decreased by five is three.)

   a. $7 + x = 12$ (A number added to seven equals twelve.)

   f. $x \div 4 = 2$ (A number divided by 4 is 2.)

   c. $3x = 0$ (A number times 3 equals 0.)

   e. $8x = 6 + 2$ (The product of 8 and a number is the same as six plus two.)

   d. $3(x - 10) = 15$ (Three times the difference of a number and ten is 15.)

Answer to Lesson 6.1A Practice 1

1. The equation is: $7 = 3 + 4$
2. The equation is: $8 + 4 = 12$
3. There are a variety of methods.

   Did you try adding some numbers to 13 until you got 25?

   For example, $13 + 10 = 23$, $13 + 11 = 24$, $13 + 12 = 25$, so the value is 12.

   Or did you subtract 13 from 25 to get 12 ($25 - 13 = 12$)?

   The value of the block is 12.

   $25 = 13 + 12$

Answer to Lesson 6.1A Practice 2

1. a. Equal

   b. Equal

   c. Not Equal

   d. Equal

   e. Equal

f. Not Equal

g. Equal

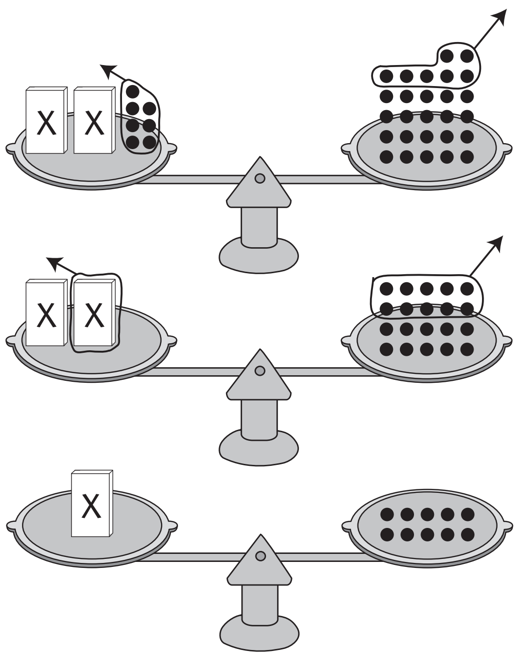
h. Equal

I. Not Equal

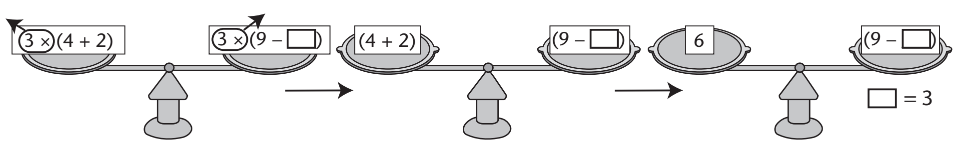
2. a. 6 counters

7 counters need to be removed from the left hand side.

b. 1 block equals 10 counters



c. 3



d. 30

e. 5

3. Answers will vary—some examples might be:

6 + 6 = 12

2(6) = 12

14 – 2 = 12

Answer to Lesson 6.1B Practice 1

1.

EQUATION	COEFFICIENTS	TERMS	VARIABLES
$x + 5y = 11$	The coefficient of x is 1 (remember $x = 1x$) The coefficient of $5y$ is 5	x, $5y$, 11	x, y
$4a + b = 26$	The coefficient of $4a$ is 4 The coefficient of b is 1	$4a$, b, 26	a, b

2. a. 8
   b. 1
   c. 5
   d. ½
   e. 1
   f. 1.4
   g. 11

3. a. Constant term = 2
   b. Constant term = 7

Answer to Lesson 6.1B Practice 2

a. expression
b. equation
c. expression
d. expression
e. equation
f. equation
g. equation
h. expression

Answer to Lesson 6.1B Practice 3

WORD	OPERATION	SYMBOL	EXAMPLE	LET n = NUMBER
a. plus	add	+	a number plus five	$n + 5$
b. minus	subtract	–	a number minus three	$n - 3$
c. more than	add	+	six more than a number	$n + 6$
d. less than	subtract	–	two less than a number	$n - 2$
e. increased by	add	+	a number increased by four	$n + 4$
f. decreased by	subtract	–	a number decreased by one	$n - 1$
g. the sum of	add	+	the sum of a number and seven	$n + 7$
h. the difference between	subtract	–	the difference between a number and one	$n - 1$
i. the product of	multiply	×	the product of a number and four	$4n$ or $4 \times n$
j. the quotient of	divide	÷	the quotient of a number and five	$\frac{n}{5}$ or $n \div 5$
k. twice	multiply by 2	× 2	twice a number	$2n$ or $2 \times n$
l. triple	multiply by 3	× 3	triple the sum of a number and four	$3(n + 4)$
m. half	multiply by ½ or divide by 2	× ½ or ÷ 2	half a number	$\frac{n}{2}$ or $\frac{1}{2} \times n$
n. of	multiply	×	one-third of a number	$\frac{n}{3}$ or $\frac{1}{3} \times n$

Answer to Lesson 6.1B Practice 4

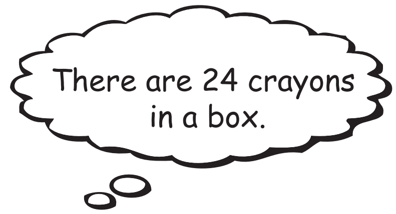
(For 1-4, remember, there is more than one way to translate an equation into words, as long as both sides remain equal.)

1. a. Four plus a number is 6.
   b. Three less than a number equals nine, or a number minus three is nine.
   c. Two plus a number is seven.
   d. Three times a number is 12.
   e. The product of 5 and a number plus one equals 37.
2. b. $6 + x = 11$,
   c. $n - 7 = 5$,
   h. $5x = 35$,
   g. $w + 2 = 8$,
   d. $\frac{1}{2}h = 12$,
   f. $4 + x = 16$,
   a. $4(2x) = 16$,
   e. $2(x + 3) = 18$
3. b. A number decreased by five is three.
   a. A number added to seven equals twelve.
   g. A number divided by 4 is 2.
   c. A number times 3 equals 0.
   f. The product of 8 and a number is the same as six plus two.
   e. Five multiplied by the product of 2 and a number equals 40.
   d. Three times the difference of a number and ten is 15.

Answer to Section Challenge 6.1

1. How many used pencil crayons do you have?

   Use pencil crayons = 2 full boxes + 5
   (the ones from my = 2(24) + 5
   brother) = 48 + 5
   = 53



   I have 53 used pencil crayons

2. How many pencil crayons do you have in total (new and used)?

   The total number of = new pencil crayons + used pencil crayons
   pencil crayons = (the one I bought) + (from my brother)
   Total = new + used
   = 24 + 53
   = 77

   I have 77 pencil crayons in total.

Answer to Pretest 6.2

Lesson 6.2A

1.

a.

$$\begin{aligned} 3x &= 24 \\ \frac{3x}{(\div \mathbf{3})} &= \frac{24}{(\div \mathbf{3})} \\ x &= \mathbf{8} \end{aligned}$$

b.

$$\begin{aligned} 5x &= 50 \\ \frac{5x}{(\div \mathbf{5})} &= \frac{50}{(\div 5)} \\ x &= \mathbf{10} \end{aligned}$$

2.

a.

$$\begin{aligned} \frac{n}{3} &= 12 \\ (\times 3)\frac{n}{3} &= 12(\times 3) \\ n &= \mathbf{36} \end{aligned}$$

b.

$$\begin{aligned} \frac{n}{4} &= 72 \\ (\times 4)\frac{n}{4} &= 72(\times 4) \\ n &= \mathbf{288} \end{aligned}$$

c.

$$\begin{aligned} \frac{n}{5} &= 35 \\ (\times \mathbf{5})\frac{n}{5} &= 35(\times \mathbf{5}) \\ n &= \mathbf{175} \end{aligned}$$

3. a. $r = 3$

   b. $q = 6$

   c. $x = 45$

4.

$$\begin{aligned} x - 9 &= 3 \\ (+9) &= (+9) \\ x + 0 &= 12 \\ x &= 12 \end{aligned}$$

Lesson 6.2B

1. a. $x + 5 = 17$

   b. Solve

$$\begin{aligned} x + 5 &= 17 \\ (-5) \quad & (-5) \\ x &= 12 \end{aligned}$$

   c. Check: Substitute 12 for x.

$$\begin{aligned} x + 5 &= 17 \\ (12) + 5 &= 17 \\ 17 &= 17 \end{aligned}$$ Smile!!

2.

a.

$$\begin{aligned} 4a &= 32 \\ \frac{4a}{(\div 4)} &= \frac{32}{(\div 4)} \\ a &= \mathbf{8} \end{aligned}$$

b.

$$\begin{aligned} \frac{1}{3}a &= 21 \\ (\times 3)\frac{1}{3}a &= \frac{21}{(\times \mathbf{3})} \\ a &= \mathbf{63} \end{aligned}$$

c.

$$\begin{aligned} 8x &= 32 \\ \frac{8x}{(\div \mathbf{8})} &= \frac{32}{(\div \mathbf{8})} \\ x &= \mathbf{4} \end{aligned}$$

d.

$$\begin{aligned} \frac{1}{2}b &= 6 \\ (\times \mathbf{2})\frac{1}{2}b &= \frac{6}{(\times \mathbf{2})} \\ b &= \mathbf{12} \end{aligned}$$

3.

a. 12

b. 2

c. 84

d. 2

Lesson 6.2C

a.

$$\begin{aligned} 3 + x &= 8 \\ 3 + x &= 8 \\ (-3) \quad & (-3) \\ x &= 5 \end{aligned}$$

b.

$$\begin{aligned} q - 11 &= 18 \\ \frac{q - 11}{(+11)} &= \frac{18}{(+11)} \\ q &= 29 \end{aligned}$$

Lesson 6.2D

1.

$$
\begin{aligned}
2n + 8 &= 30 \\
2n + 8 &= 30 \\
(-8) \quad & \quad (-8) \\
2n &= 22 \\
2n &= 22 \\
(\div 2) \quad & \quad (\div 2) \\
n &= 11
\end{aligned}
$$

Verify:

$$
\begin{aligned}
2n + 8 &= 30 \\
2(11) + 8 &= 30 \\
22 + 8 &= 30 \\
30 &= 30
\end{aligned}
$$

2.

$$
\begin{aligned}
5n - 4 &= 11 \\
5n - 4 &= 11 \\
(+4) \quad & \quad (+4) \\
5n &= 15 \\
5n &= 15 \\
(\div 5) \quad & \quad (\div 5) \\
n &= 3
\end{aligned}
$$

Verify:

$$
\begin{aligned}
5n - 4 &= 11 \\
5(3) - 4 &= 11 \\
15 - 4 &= 11 \\
11 &= 11
\end{aligned}
$$

3.

$$
\begin{aligned}
\frac{n}{3} + 6 &= 10 \\
\frac{n}{3} + 6(-6) &= 10(-6) \\
\frac{n}{3} &= 4 \\
(\times 3)\frac{n}{3} &= 4(\times 3) \\
n &= 12
\end{aligned}
$$

Verify:

$$
\begin{aligned}
\frac{n}{3} + 6 &= 10 \\
\frac{(12)}{3} + 6 &= 10 \\
4 + 6 &= 10 \\
10 &= 10
\end{aligned}
$$

Answer to Lesson 6.2A Warm-up

1. a. 9

   b. 14

   c. 5

   d. 18

   e. 59

2. a. 4

   b. 4

   c. 8

   d. 48

   e. 33

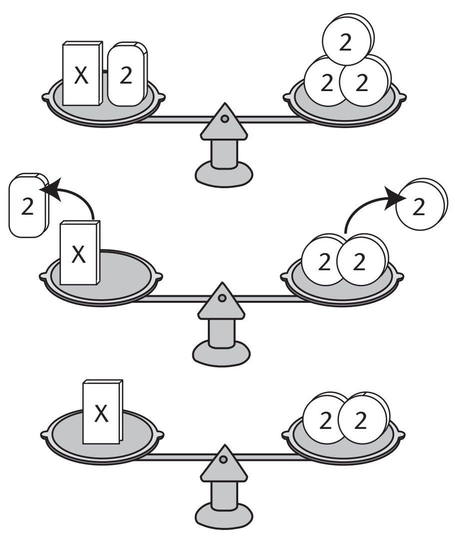
Answer to Lesson 6.2A Practice 1

1. a. $x + 3 = 21$

   b. $12 = 2 + x$

2.

Scales



Equation

$x + 2 = 6$

$x + 2 = 6$
$(-2) \quad (-2)$

$x = 4$

Answer to Lesson 6.2A Practice 2

1. $c - 3 = 7$
   $(+3) \quad (+3)$
   $c = 10$

2. $x + 3 = 11$
   $(-3) \quad (-3)$
   $x = 8$

3. $p - 3 = 10$
   $(+3) \quad (+3)$
   $p = 13$

4. $m + 14 = 21$
   $(-14) \quad (-14)$
   $x = 7$

Answer to Lesson 6.2A Practice 3

1. a. 10
   b. 5
   c. 28
2. a. yes
   b. no
   c. no
3. a.
   $$3 + x = 8$$
   $$3 + x = 8$$
   $$(-3) \quad (-3)$$
   $$x = 5$$

   b.
   $$q - 11 = 18$$
   $$q - 11 = 18$$
   $$(+11) \quad (+11)$$
   $$q = 29$$

   c.
   $$x - 10 = 2$$
   $$x - 10 = 2$$
   $$(+10) \quad (+10)$$
   $$x = 12$$

   d.
   $$3 + x = 19$$
   $$3 + x = 19$$
   $$(-3) \quad (-3)$$
   $$x = 16$$

   e.
   $$w - 25 = 50$$
   $$w - 25 = 50$$
   $$(+25) \quad (+25)$$
   $$w = 75$$

   f.
   $$a - 8 = 8$$
   $$a - 8 = 8$$
   $$(+8) \quad (+8)$$
   $$a = 16$$

g. $x + 15 = 27$

$$\begin{aligned} x + 15 &= 27 \\ (-15) \quad &(-15) \\ x &= 12 \end{aligned}$$

h. $x - 47 = 62$

$$\begin{aligned} x - 47 &= 62 \\ (+47) \quad &(+47) \\ x &= 109 \end{aligned}$$

Answer to Lesson 6.2A Practice 4

1. a.

$$\begin{aligned} x - 6 &= 8 \\ x - 6 &= 8 \\ (+6) \quad &(+6) \\ x &= 14 \end{aligned}$$

Check:

$$\begin{aligned} x - 6 &= 8 \\ (14) - 6 &= 8 \\ 8 &= 8 \end{aligned}$$

b.

$$\begin{aligned} x + 3 &= 12 \\ x + 3 &= 12 \\ (-3) \quad &(-3) \\ x &= 9 \end{aligned}$$

Check:

$$\begin{aligned} x + 3 &= 12 \\ (9) + 3 &= 12 \\ 12 &= 12 \end{aligned}$$

c.

$$\begin{aligned} 4 + x &= 25 \\ 4 + x &= 25 \\ (-4) \quad &(-4) \\ x &= 21 \end{aligned}$$

Check:

$$\begin{aligned} 4 + x &= 25 \\ 4 + (21) &= 25 \\ 25 &= 25 \end{aligned}$$

d.

$$\begin{aligned} x + 11 &= 19 \\ x + 11 &= 19 \\ (-11) \quad &(-11) \\ x &= 8 \end{aligned}$$

Check:

$$\begin{aligned} x + 11 &= 19 \\ (8) + 11 &= 19 \\ 19 &= 19 \end{aligned}$$

2.

$$\begin{aligned} x - 7 &= 31 \\ x - 7 &= 31 \\ (+7) \quad &(+7) \\ x &= 38 \end{aligned}$$

Check:

$$\begin{aligned} x - 7 &= 31 \\ (38) - 7 &= 31 \\ 31 &= 31 \end{aligned}$$

Alex started with 38 hockey cards.

Answer to Lesson 6.2B Warm-up

1.

Term(s)	Variable	Coefficient	Constant Term
a. 3			**3**
b. $3a$	$\boldsymbol{a}$	**3**	
c. $2n + 3$	$\boldsymbol{n}$	**2**	**3**
d. ab	$\boldsymbol{a, b}$		
e. $\frac{r}{2}$	$\boldsymbol{r}$	$\mathbf{\frac{1}{2}}$	
f. $\frac{x}{3}$	$\boldsymbol{x}$	$\mathbf{\frac{1}{3}}$	
g. x	$\boldsymbol{x}$	**1**	

2. a. $7 \times 3 = 21$
   b. $6 \times 4 = 24$
   c. $3 \times 8 = 24$
   d. $15 \times 3 = 45$
   e. $18 \times 25 = 450$
   f. $8 \times 9 = 72$
   g. $8 \times 7 = 56$
   h. $2 \times 11 = 22$
   i. $5(6) = 30$
   j. $5(3)(2) = 30$
   k. $16(4)(5) = 320$

l. (3)(7)(5) = 105

3. a. 15 ÷ 5 = 3

   b. 36 ÷ 6 = 6

   c. 24 ÷ 2 = 12

   d. 125 ÷ 5 = 25

   e. 56 ÷ 8 = 7

   f. 49 ÷ 7 = 7

   g. 18 ÷ 3 = 6

   h. 32 ÷ 4 = 8

   i. 36 ÷ 4 = 9

Answer to Lesson 6.2B Practice 1

1. a. 3

   b. one block = 13

2.
   a.
$$\begin{gathered} 3x = 24 \\ 3x = 24 \\ (\div 3) \quad (\div 3) \\ x = 8 \end{gathered}$$

   b.
$$\begin{gathered} 2x = 14 \\ 2x = 14 \\ (\div 2) \quad (\div 2) \\ x = 7 \end{gathered}$$

   c.
$$\begin{gathered} 4y = 160 \\ 4y = 160 \\ (\div 4) \quad (\div 4) \\ y = 40 \end{gathered}$$

   d.
$$\begin{gathered} 5x = 50 \\ 5x = 50 \\ (\div 5) \quad (\div 5) \\ x = 10 \end{gathered}$$

Answer to Lesson 6.2B Practice 2

1. a. 36 counters fill one cup

   b. 168 circles

2.

a.
$$\begin{aligned} \frac{n}{3} &= 12 \\ (\times 3)\frac{n}{3} &= 12(\times 3) \\ n &= \mathbf{36} \end{aligned}$$

b.
$$\begin{aligned} \frac{n}{4} &= 72 \\ (\times 4)\frac{n}{4} &= 72(\times 4) \\ n &= \mathbf{288} \end{aligned}$$

c.
$$\begin{aligned} \frac{n}{5} &= 35 \\ (\times 5)\frac{n}{5} &= 35(\times 5) \\ n &= \mathbf{175} \end{aligned}$$

d.
$$\begin{aligned} \frac{n}{8} &= 56 \\ (\times 8)\frac{n}{8} &= 56(\times 8) \\ n &= \mathbf{448} \end{aligned}$$

e.
$$\begin{aligned} \frac{n}{6} &= 36 \\ (\times 6)\frac{n}{6} &= 36(\times 6) \\ n &= \mathbf{216} \end{aligned}$$

3. a. 3

   b. 6

   c. 45

   d. 28

   e. 0

Answer to Lesson 6.2B Practice 3

1. a. 20

   b. 5

   c. 1

   d. 20 – 8 = 12

2. a. yes

   b. no

   c. yes

   d. yes

3.

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

4.

a.

$$4a = 32$$
$$4a = 32$$
$$(\div 4) \quad (\div 4)$$
$$a = \mathbf{8}$$

b.

$$\frac{1}{3}a = 21$$
$$(\times 3)\frac{1}{3}a = 21(\times \mathbf{3})$$
$$a = \mathbf{63}$$

c.

$$8x = 32$$
$$8x = 32$$
$$(\div \mathbf{8}\ ) \quad (\div \mathbf{8}\ )$$
$$x = \mathbf{4}$$

d.

$$\frac{1}{2}b = 6$$
$$(\times \mathbf{2})\frac{1}{2}b = 6(\times \mathbf{2})$$
$$b = \mathbf{12}$$

5. a. 12
   b. 2
   c. 84
   d. 2

Answer to Lesson 6.2C Warm-up

a. $4 \times 8 - 4 \div 2$

$= 32 - 2$

$= 30$

b. $10 - (7 - 2)$

$= 10 - 5$

$= 5$

c. $\dfrac{17-8}{3}$

$= \dfrac{9}{3}$

$= 3$

d. $5 \times 3 + 9 \div 3$

$= 15 + 3$

$= 18$

e. $14 - 3 \times 2 + 1$

$= 14 - 6 + 1$

$= 9$

Answer to Lesson 6.2C Practice 1

1. a. equation
   b. solution
   c. inverse
   d. division
   e. substituting
   f. other
   g. isolate
2. Let x = 1 cup

Equation:

$3x + 7 = 22$

$3x + 7 = 22$

$(-7)\ (-7)$

$3x = 15$

$(\div 3)\ (\div 3)$

$x = 5$

Verify:

$3x + 7 = 22$

$3(5) + 7 = 22$

$15 + 7 = 22$

$22 = 22$

Smile!!

Answer to Lesson 6.2C Practice 2

1. a. $2x - 5 = 7$

Solve:

Step 1:
$$\begin{aligned} 2x - 5 &= 7 \\ +5 \quad & \quad +5 \\ 2x &= 12 \end{aligned}$$

Step 2:
$$\begin{aligned} 2x &= 12 \\ \div 2 \quad & \quad \div 2 \\ x &= 6 \end{aligned}$$

Check your answer:

$$\begin{aligned} 2x - 5 &= 7 \\ 2(6) - 5 &= 7 \\ 12 - 5 &= 7 \\ 7 &= 7 \end{aligned}$$

b. $4y + 6 = 18$

Solve:

Step 1:
$$\begin{aligned} 4y + 6 &= 18 \\ (-6) \quad & \quad (-6) \\ 4y &= 12 \end{aligned}$$

Step 2:
$$\begin{aligned} 4y \div 4 &= 12 \div 4 \\ y &= 3 \end{aligned}$$

Check your answer:

$$\begin{aligned} 4y + 6 &= 18 \\ 4(3) + 6 &= 18 \\ 12 + 6 &= 18 \\ 18 &= 18 \end{aligned}$$

Did you smile?

c. $y \div 4 - 2 = 14$

Solve:

$$\frac{y}{4} - 2 = 14$$
$$(+2) \quad (+2)$$
$$\frac{y}{4} = 16$$
$$\frac{y}{4} = 16$$
$$(\times 4) \quad (\times 4)$$
$$y = 64$$

Check your answer:

$$\left(\frac{64}{4}\right) - 2 = 14$$
$$\frac{64}{4} - 2 = 14$$
$$16 - 2 = 14$$
$$14 = 14$$

Did you smile?

d. $\frac{x}{3} + 6 = 10$

Solve:

$$\frac{x}{3} + 6 = 10$$

Step 1:

$$\frac{x}{3} + 6 = 10 \text{ (Inverse of addition is subtraction}$$
$$(-6) \ (-6) \text{ (Subtract both sides by 6)}$$

$$\frac{x}{3} = 4$$

Step 2:

$$\frac{x}{3} = 4 \text{ (Inverse of division is multiplication)}$$
$$(\text{x } 3) \ (\text{x } 3) \text{ (Multiply both sides by 3)}$$
$$x = 12$$

Substitute:

$$\frac{x}{3} + 6 = 10$$
$$\left(\frac{12}{3}\right) \div 3 + 6 = 10$$
$$\frac{12}{3} + 6 = 10$$
$$4 + 6 = 10$$
$$10 = 10$$

Smile!

2.

a. Verify:

$$2x + 4 = 10$$
$$2x + 4 = 10$$
$$(-4) \quad (-4)$$
$$2x = 6$$
$$2x = 6$$
$$(\div 2) \quad (\div 2)$$
$$x = 3$$

$$2x + 4 = 10$$
$$2(3) + 4 = 10$$
$$6 + 4 = 10$$
$$10 = 10$$

b. Verify:

$$3x - 5 = 4$$
$$3x - 5 = 4$$
$$(+5) \quad (+5)$$
$$3x = 9$$
$$3x = 9$$
$$(\div 3) \quad (\div 3)$$
$$x = 3$$

$$3x - 5 = 4$$
$$3(3) - 5 = 4$$
$$9 - 5 = 4$$
$$4 = 4$$

c. Verify:

$$\frac{1}{2}x + 4 = 10$$
$$(-4)\frac{1}{2}x + 4 = 10(-4)$$
$$(-4) \quad (-4)$$
$$\frac{1}{2}x = 6$$
$$\frac{1}{2}x = 6$$
$$(x2) \quad (x2)$$
$$x = 12$$

$$\frac{1}{2}x + 4 = 10$$
$$\frac{1}{2}(12) + 4 = 10$$
$$6 + 4 = 10$$
$$10 = 10$$

d. Verify:

$$\frac{1}{3}x - 2 = 4$$
$$(+2)\frac{1}{3}x - 2 = 4(+2)$$
$$(+2) \quad (+2)$$
$$\frac{1}{3}x = 6$$
$$\frac{1}{3}x = 6$$

$$\frac{1}{3}x - 2 = 4$$
$$\frac{1}{3}(18) - 2 = 4$$
$$6 - 2 = 4$$
$$4 = 4$$

Answer to Lesson 6.2C Practice 3

1.

a.

$$2n + 8 = 30$$
$$\begin{aligned} 2n + 8 &= 30 \\ (-8) \quad &(-8) \\ 2n &= 22 \end{aligned}$$
$$\begin{aligned} 2n &= 22 \\ (\div 2) \quad &(\div 2) \\ n &= 11 \end{aligned}$$

Verify:

$$\begin{aligned} 2n + 8 &= 30 \\ 2(11) + 8 &= 30 \\ 22 + 8 &= 30 \\ 30 &= 30 \end{aligned}$$

b.

$$5n - 4 = 11$$
$$\begin{aligned} 5n - 4 &= 11 \\ (+4) \quad &(+4) \\ 5n &= 15 \end{aligned}$$
$$\begin{aligned} 5n &= 15 \\ (\div 5) \quad &(\div 5) \\ n &= 3 \end{aligned}$$

Verify:

$$\begin{aligned} 5n - 4 &= 11 \\ 5(3) - 4 &= 11 \\ 15 - 4 &= 11 \\ 11 &= 11 \end{aligned}$$

c.

$$\frac{n}{3} + 6 = 10$$
$$\begin{aligned} \frac{n}{3} + 6 &= 10 \\ (-6) \quad &(-6) \\ \frac{n}{3} &= 4 \end{aligned}$$
$$\begin{aligned} \frac{n}{3} &= 4 \\ (\times 3) \quad &(\times 3) \\ n &= 12 \end{aligned}$$

Verify:

$$\begin{aligned} \frac{n}{3} + 6 &= 10 \\ \frac{12}{3} + 6 &= 10 \\ 4 + 6 &= 10 \\ 10 &= 10 \end{aligned}$$

2.

$$5x + 5 = 100$$

$$\begin{aligned} 5x + 5 &= 100 \quad \boxed{1} \\ (-5)\ &\ (-5) \\ 5x &= 95 \end{aligned}$$

$$\begin{aligned} 5x &= 95 \quad \boxed{2} \\ (\div 5)&(\div 5) \\ x &= 19 \end{aligned}$$

Each block is 19 cm in height.

3. Let x = number of leaves

$$3x - 5 = 46$$

$$\begin{aligned} 3x - 5 &= 46 \\ (+5)\ &\ (+5) \\ 3x &= 51 \\ 3x &= 51 \\ (\div 3)&(\div 3) \\ x &= 17 \end{aligned}$$

Check:

$$\begin{aligned} 3x - 5 &= 46 \\ 3(17) - 5 &= 46 \\ 51 - 5 &= 46 \\ 46 &= 46 \end{aligned}$$

Stephanie has 17 leaves in her collection.

Answer to Section Challenge 6.2

Let r = the number of raspberries Tony has in the pail.

$$\begin{aligned} 5r + 500 &= 3500 \\ (-500)\ &\ (-500) \\ 5r &= 3000 \\ (\div 5)\ &\ (\div 5) \\ r &= 600 \end{aligned}$$

Tony has 600 raspberries.

Module 6 Glossary

Coefficient

The number in front of the variable. In the expression $2x$, 2 is the coefficient and x is the variable. The expression means "2 times x."

Constant

A term with no variable. If the term has no variable, it can't ever change. It is constant.

Equation

An equation is made up of two expressions separated by an equal sign.

Expression

A group of numbers and symbols that expresses the idea of a pattern. Examples of expressions are:

$7x$	$2p - 3q + 7$
$9t + 3v$	$a - b + 3c$
$7d - 3$	$2m - n$
$x + 2y - 3$	$4j + 1$

Fulcrum

The centre point of a balance scale.

Isolate the Variable

To get the variable by itself.

Preserving Equality

Each side of the equal sign must be equal to the other. Preserving equality is what you do to one side of the equation to make it equal to the other.

Quotient

The answer in a division question.

Solving an Equation

Finding the solution that makes the equation true.

Substitution

Replacing the variable with its value.
For example: substitute $x = 4$ in the expression $2x - 1$.

$$\begin{aligned}&2x-1\\&=2(4)-1\\&=8-1\\&=7\end{aligned}$$

Terms

"Words" that make up an expression or equation. They can be a number, a letter, or a product of a number.

Variable

A variable in an expression represents an "unknown."

Verify Your Solution

Check your answer.