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SHELL
EDUCATION

PRACTICE - ASSESS - DIAGNOSE

Level

6

180 Days of

PROBLEM SOLVING

for Sixth Grade

- Think
- Plan
- Solve
- Explain



$$-3 > -10$$

TABLE OF CONTENTS

Introduction	3
How to Use this Book	4
Standards Correlations	12
Daily Practice Pages	13
Answer Key	193
Practice Page Rubric	219
Practice Page Item Analysis	220
Student Item Analysis	224
Problem-Solving Framework	225
Problem-Solving Strategies	226
Digital Resources	227

INTRODUCTION

The Need for Practice

To be successful in today’s mathematics classrooms, students must deeply understand both concepts and procedures so that they can discuss and demonstrate their understanding during the problem-solving process. Demonstrating understanding is a process that must be continually practiced for students to be successful. Practice is especially important to help students apply their concrete, conceptual understanding during each step of the problem-solving process.

Understanding Assessment

In addition to providing opportunities for frequent practice, teachers must be able to assess students’ problem-solving skills. This is important so that teachers can adequately address students’ misconceptions, build on their current understandings, and challenge them appropriately. Assessment is a long-term process that involves careful analysis of student responses from discussions, projects, practice pages, or tests. When analyzing the data, it is important for teachers to reflect on how their teaching practices may have influenced students’ responses and to identify those areas where additional instruction may be required. In short, the data gathered from assessments should be used to inform instruction: slow down, speed up, or reteach. This type of assessment is called *formative assessment*.

HOW TO USE THIS BOOK *(cont.)*

College-and-Career Readiness Standards

Below is a list of mathematical standards that are addressed throughout this book. Each week students solve problems related to the same mathematical topic.

Week	Standard
1	Find the greatest common factor of two whole numbers less than or equal to 100.
2	Find the least common multiple of two whole numbers less than or equal to 12.
3	Use the distributive property to express a sum of two whole numbers 1–100 with a common factor as a multiple of a sum of two whole numbers with no common factor.
4	Fluently divide multi-digit numbers using the standard algorithm.
5	Interpret and compute quotients of fractions, and solve word problems involving division of fractions by fractions, e.g., by using visual fraction models and equations to represent the problem.
6	Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation.
7	Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.
8	Understand the concept of a unit rate $\frac{a}{b}$ associated with a ratio $a:b$ with $b \neq 0$, and use rate language in the context of a ratio relationship.
9	Make tables of equivalent ratios relating quantities with whole-number measurements, find missing values in the tables, and plot the pairs of values on the coordinate plane. Use tables to compare ratios.
10	Solve unit rate problems including those involving unit pricing and constant speed.
11	Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means $\frac{30}{100}$ times the quantity); solve problems involving finding the whole, given a part and the percent.
12	Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.
13	Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation.
14	Recognize opposite signs of numbers as indicating locations on opposite sides of 0 on the number line; recognize that the opposite of the opposite of a number is the number itself, e.g., $-(-3) = 3$, and that 0 is its own opposite. Find and position integers and other rational numbers on a horizontal or vertical number line diagram; find and position pairs of integers and other rational numbers on a coordinate plane.

HOW TO USE THIS BOOK *(cont.)*

15	<p>Understand signs of numbers in ordered pairs as indicating locations in quadrants of the coordinate plane; recognize that when two ordered pairs differ only by signs, the locations of the points are related by reflections across one or both axes.</p> <p>Find and position integers and other rational numbers on a horizontal or vertical number line diagram; find and position pairs of integers and other rational numbers on a coordinate plane.</p>
16	<p>Interpret statements of inequality as statements about the relative position of two numbers on a number line diagram.</p> <p>Write, interpret, and explain statements of order for rational numbers in real-world contexts.</p>
17	<p>Understand the absolute value of a rational number as its distance from 0 on the number line; interpret absolute value as magnitude for a positive or negative quantity in a real-world situation.</p> <p>Distinguish comparisons of absolute value from statements about order.</p>
18	<p>Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate.</p>
19	<p>Draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate. Apply these techniques in the context of solving real-world and mathematical problems.</p>
20	<p>Write and evaluate numerical expressions involving whole-number exponents.</p>
21	<p>Write expressions that record operations with numbers and with letters standing for numbers.</p> <p>Identify parts of an expression using mathematical terms (sum, term, product, factor, quotient, coefficient); view one or more parts of an expression as a single entity.</p> <p>Evaluate expressions at specific values of their variables. Include expressions that arise from formulas used in real-world problems. Perform arithmetic operations, including those involving whole-number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations).</p>
22	<p>Apply the properties of operations to generate equivalent expressions.</p> <p>Identify when two expressions are equivalent (i.e., when the two expressions name the same number regardless of which value is substituted into them).</p>
23	<p>Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true? Use substitution to determine whether a given number in a specified set makes an equation or inequality true.</p>
24	<p>Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.</p>
25	<p>Solve real-world and mathematical problems by writing and solving equations of the form $x + p = q$ and $px = q$ for cases in which p, q and x are all nonnegative rational numbers.</p>

HOW TO USE THIS BOOK *(cont.)*

26	Write an inequality of the form $x > c$ or $x < c$ to represent a constraint or condition in a real-world or mathematical problem. Recognize that inequalities of the form $x > c$ or $x < c$ have infinitely many solutions; represent solutions of such inequalities on number line diagrams.
27	Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. For example, in a problem involving motion at constant speed, list and graph ordered pairs of distances and times, and write the equation $d = 65t$ to represent the relationship between distance and time.
28	Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems.
29	Find the volume of a right rectangular prism with fractional edge lengths by packing it with unit cubes of the appropriate unit fraction edge lengths, and show that the volume is the same as would be found by multiplying the edge lengths of the prism.
30	Apply the formulas $V = lwh$ and $V = bh$ to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems.
31	Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures. Apply these techniques in the context of solving real-world and mathematical problems.
32	Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers.
33	Understand that a set of data collected to answer a statistical question has a distribution, which can be described by its center, spread, and overall shape.
34	Recognize that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number.
35	Display numerical data in plots on a number line, including dot plots, histograms, and box plots.
36	Report the number of observations. Describe the nature of the attribute under investigation, including how it was measured and its units of measurement. Give quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describe any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered. Relate the choice of measures of center and variability to the shape of the data distribution and the context in which the data were gathered.

NAME: _____ DATE: _____

DIRECTIONS: Think about the problem, and answer the questions.



Think About It!



Gus's homework assignment is to find two numbers less than 50 with a greatest common factor of 8. He is not allowed to use 8 as one of the solution numbers. His solution pair is 16 and 32. Is Gus's solution correct?

- 1. What information do you know?

- 2. What do you need to find?

- 3. Why do you think Gus is not allowed to use 8 as a solution number?

NAME: _____ DATE: _____

DIRECTIONS: Read and solve the problem.

Problem: Gus's homework assignment is to find two numbers less than 50 with a greatest common factor of 8. He is not allowed to use 8 as one of the solution numbers. His solution pair is 16 and 32. Is Gus's solution correct?



? **What Do You Know?**

key **What Is Your Plan?**

lightbulb **Solve the Problem!**

magnifying glass **Look Back and Explain!**

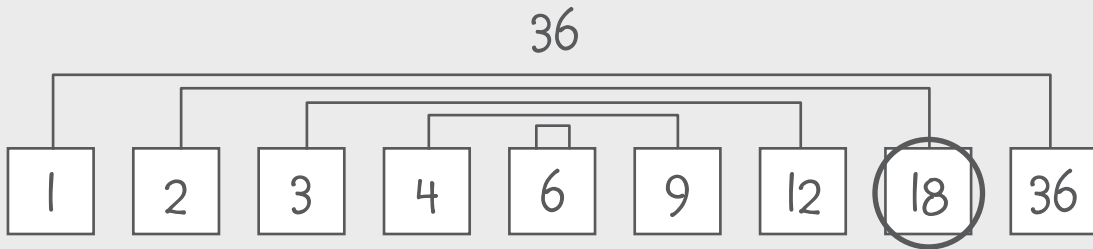
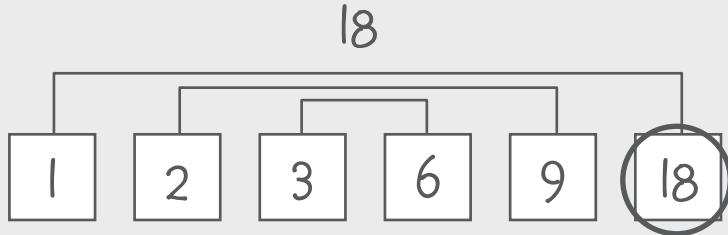
Solve It!

NAME: _____ DATE: _____



Look at the example. Then, solve the problem.

Example: What is the greatest common factor of 18 and 36?



The greatest common factor is 18.

What is the greatest common factor of 12 and 32?

The greatest common factor is _____.



Visualize It!

NAME: _____ DATE: _____

DIRECTIONS: Show two ways to solve the riddle.

1. Riddle:

Both numbers are even.
Both numbers are greater than 16 but less than 90.
The greatest common factor of the two numbers is 16.
What are the two numbers?

..... Strategy 1

..... Strategy 2

2. Which strategy was more efficient? Explain your reasoning.

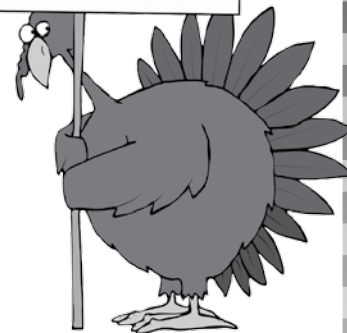
NAME: _____ DATE: _____



Read and solve the problem.

Jerome's Deli is preparing combination plates with at least one type of sandwich on each plate. There are 96 turkey club sandwiches, 64 ham and cheese sandwiches, and 32 meatball sandwiches. How many combination plates can the deli prepare if it wants the greatest number of plates possible, with the same number of sandwiches on each? How many of each type of sandwich will be on each combination plate?

Eat Ham!



Challenge Yourself!

1. Choose a strategy to show the number of combination plates.

2. Explain how you determined how many of each sandwich will be on each plate.

PROBLEM-SOLVING FRAMEWORK

Use the following problem-solving steps to help you:

1. understand the problem
2. make a plan
3. solve the problem
4. check your answer and explain your thinking



What Do You Know?

- read/reread the problem
- restate the problem in your own words
- visualize the problem
- find the important information in the problem
- understand what the question is asking

What Is Your Plan?

- draw a picture or model
- decide which strategy to use
- choose an operation (+, −, ×, ÷)
- determine if there is one step or multiple steps



Solve the Problem!

- carry out your plan
- check your steps as you are solving the problem
- decide if your strategy is working or choose a new strategy
- find the solution to the problem

Look Back and Explain!

- check that your solution makes sense and is reasonable
- determine if there are other possible solutions
- use words to explain your solution

