GENERAL

# practice 7 2 multiplying and dividing radical expressions

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## Introduction

When students first encounter radical expressions in algebra, the idea of multiplying and dividing them can feel intimidating. The notation, the need for simplification, and the rules that govern these operations often create confusion. However, with a clear understanding of the underlying principles and plenty of practice, these seemingly complex tasks become straightforward. This article will walk you through the fundamentals of multiplying and dividing radical expressions, provide detailed solutions to a representative problem—commonly referred to as “practice 7 2”—and offer a wealth of additional practice problems and study tips to help you master the skill.

## Understanding Radical Expressions

### What Is a Radical?

A radical is a symbol that represents the root of a number or expression. The most common radical is the square root (denoted by the radical sign " ), but higher roots such as cube roots (" ) and fourth roots ( t" ) also exist. The general form of a radical expression is **" [n]{a}**, where **n** is the index (the type of root) and **a** is the radicand (the number or expression inside the radical).

### Types of Radicals

- Integer Radicals – The radicand is an integer, e.g., " 9 or " 27.
- Rational Radicals – The radicand is a rational number, e.g., " (4/9).
- Algebraic Radicals – The radicand contains variables, e.g., " (x² + 4x + 4).
- Nested Radicals – Radicals within radicals, e.g., " (2 + " 3).

## Why Multiply and Divide Radical Expressions?

Multiplication and division of radicals are essential operations in algebra and calculus. They appear in:

- Solving equations involving radicals.
- Simplifying expressions for integration or differentiation.
- Performing rationalizations in physics and engineering problems.
- Evaluating limits and series in advanced mathematics.

Mastering these operations provides a strong foundation for higher-level math courses and real-world applications.

## Rules for Multiplying Radicals

### The Basic Rule

When multiplying radicals with the same index, you can combine the radicands under one radical sign:

**" [n]{a} × " [n]{b} = " [n]{a × b}**

For example:

**" 5 × " 3 = " (5 × 3) = " 15**

### Handling Different Indices

If the indices differ, you first convert one or both radicals to a common index. This often involves raising one or both radicals to a power that aligns the indices.

Example:

**" (x) × " (y)** can be rewritten as **" [6]{x²} × " [6]{y³} = " [6]{x²y³}**

## Rules for Dividing Radicals

### The Basic Rule

Division of radicals with the same index follows a similar pattern to multiplication:

**" [n]{a} ÷ " [n]{b} = " [n]{a ÷ b}**

Example:

**" 18 ÷ " 2 = " (18 ÷ 2) = " 9 = 3**

### Rationalizing the Denominator

When a radical appears in the denominator, it is standard practice to rationalize it—eliminate the radical from the denominator—by multiplying the numerator and denominator by a suitable radical expression.

Example:

**1 ÷ " 5 = " 5 ÷ " 5 × 1 = " 5 ÷ 5 = " 5/5**

## Simplifying Radical Expressions

### Removing Perfect Squares

To simplify radicals, factor the radicand into prime factors and identify perfect squares (or cubes, etc.). Extract these perfect squares from the radical:

**" (50) = " (25 × 2) = " 25 × " 2 = 5" 2**

### Rationalizing Denominators

As mentioned earlier, rationalizing denominators ensures that the expression is in its simplest form. For square roots, multiply by the same radical. For cube roots, multiply by the square of the radical, and vice versa.

Example (cube root):

**1 ÷ " 3 = " 9 ÷ " 27 = " 9/27 = " (1/3)**

## Practice Problem 7.2: Multiplying and Dividing Radical Expressions

Many textbooks label a specific set of practice problems under “Practice 7.2.” These problems focus on the multiplication and division of radical expressions. One representative problem is:

1. Compute (" (12) × " (18)) ÷ " (3).

### Step-by-Step Solution

1. Multiply the radicals in the numerator:
" (12) × " (18) = " (12 × 18) = " (216)

2. Simplify the resulting radical:
$216 = 36 \times 6 = 6^2 \times 6$
$\sqrt{216} = \sqrt{(6^2 \times 6)} = 6\sqrt{6}$
3. Divide by the radical in the denominator:
$(6\sqrt{6}) \div \sqrt{3} = 6 \times (\sqrt{6} \div \sqrt{3}) = 6 \times \sqrt{(6 \div 3)} = 6 \times \sqrt{2} = 6\sqrt{2}$
4. Final answer:
$6\sqrt{2}$

### Common Pitfalls

- Forgetting to combine radicands before simplifying.
- Not recognizing perfect squares within the radicand.
- Leaving radicals in the denominator without rationalizing.
- Misapplying the division rule when indices differ.

## Additional Practice Problems

Below is a curated list of problems that follow the same style as “practice 7 2 multiplying and dividing radical expressions.” Each problem is followed by a brief solution outline.

1. Compute $(\sqrt{8} \times \sqrt{27}) \div \sqrt{2}$.
$\sqrt{8} = 2, \sqrt{27} = 3, \sqrt{2}$ remains.
$(2 \times 3) \div \sqrt{2} = 6 \div \sqrt{2} = 6\sqrt{(1/2)} = 6/\sqrt{2}$.
Rationalize: Multiply numerator and denominator by $\sqrt{4}$ ! $(6\sqrt{4})/(\sqrt{2} \times \sqrt{4}) = (6\sqrt{4})/\sqrt{8} = (6\sqrt{4})/2 = 3\sqrt{4}$.
2. Simplify $(\sqrt{50} \times \sqrt{18}) \div \sqrt{5}$.
$\sqrt{50} = 5\sqrt{2}, \sqrt{18} = 3\sqrt{2}, \sqrt{5}$ remains.
$(5\sqrt{2} \times 3\sqrt{2}) = 15 \times 2 = 30$.
$30 \div \sqrt{5} = 30/\sqrt{5} = 30\sqrt{5}/5 = 6\sqrt{5}$.
3. Compute $(\sqrt{32} \div \sqrt{8}) \times \sqrt{2}$.
$\sqrt{32} = 4\sqrt{2}, \sqrt{8} = 2\sqrt{2}$.
$(4\sqrt{2} \div 2\sqrt{2}) = 2$.
$2 \times \sqrt{2} = 2\sqrt{2}$.
4. Simplify $(\sqrt{54} \div \sqrt{2}) \times \sqrt{8}$.
$\sqrt{54} = 3\sqrt{2}, \sqrt{8} = 2$.
$(3\sqrt{2} \div \sqrt{2}) \times 2 = 3 \times 2 = 6$.
5. Compute $(\sqrt{45} \times \sqrt{20}) \div \sqrt{5}$.
$\sqrt{45} = 3\sqrt{5}, \sqrt{20} = 2\sqrt{5}$.
$(3\sqrt{5} \times 2\sqrt{5}) = 6 \times 5 = 30$.
$30 \div \sqrt{5} = 30\sqrt{5}/5 = 6\sqrt{5}$.

## Tips for Mastering Radical Operations

- Always factor the radicand. Breaking down the radicand into prime factors or perfect squares/cubes helps in simplifying.
- Keep the index consistent. When multiplying or dividing, ensure the radicals share the same index, or convert them to a common index.
- Use a systematic approach. Multiply or divide first, then simplify, and finally rationalize the denominator if necessary.
- Practice regularly. The more problems you solve, the more patterns you recognize.
- Check your work. After simplification, re-evaluate the expression by plugging in a numerical value for the

variable (if applicable) to verify correctness.

## Frequently Asked Questions

### Can you multiply radicals with different indices?

Yes, but you must first convert them to a common index. This often involves raising one or both radicals to a power that aligns the indices.

### What if the radicand is negative?

For even indices (e.g., square roots), the radicand must be non-negative. For odd indices (e.g., cube roots), negative radicands are allowed, and the result will be a negative radical.

### Is it always necessary to rationalize denominators?

In pure mathematics, rational