# I. Lesson Overview

| Lesson Title: | Multiplying and Dividing Logarithms |
|---|---|
| Strand: | Numbers and Algebra |
| Sub-Strand: | Indices and Logarithms |
| Grade Level: | 10 |
| Estimated Duration: | 40 minutes |

## Key Inquiry Question

*How do we use real numbers in day-to-day activities?*

# II. Learning Objectives & Standards

## Learning Objectives

Upon completion of this lesson, students will be able to:

1. **Know (Conceptual Understanding):** Understand that logarithms convert multiplication to addition, division to subtraction, and powers/roots to multiplication/division of logarithms.
2. **Do (Procedural Skill):** Use logarithm tables to perform multiplication, division, and find powers and roots of numbers.
3. **Apply (Application/Problem-Solving):** Apply logarithmic calculations to solve real-world problems involving areas, volumes, and compound calculations.

## Curriculum Alignment

| Strand: | Numbers and Algebra |
|---|---|
| Sub-Strand: | Indices and Logarithms |
| Specific Learning Outcome: | Multiplying and Dividing Logarithms and Applying Logarithms to Powers and Roots |

# III. Materials & Resources

| Textbooks: | CBC Grade 10 Mathematics Learner's Book<br>CBC Grade 10 Mathematics Teacher's Book |
|---|---|
| Equipment: | Scientific calculators, Logarithm tables, Antilogarithm tables |
| Visual Aids: | Laws of logarithms chart displayed on board |

## IV. Lesson Procedure

### Phase 1: Problem-Solving and Discovery / Engage & Explore (15 minutes)

**Objective:** To explore how logarithms simplify complex calculations.

**Anchor Activity: The Calculator Challenge**

Work in groups to explore the following challenge:

**Part A: The Long Way**

Without using a calculator, try to compute:

1. $236.5 \times 42.8 = ?$

2. $528.6 \div 24.7 = ?$

3. $\sqrt[3]{524.8} = ?$

**Part B: Discovering the Pattern**

Use your logarithm tables to find:

• $\log(236.5) = ?$

• $\log(42.8) = ?$

• What do you notice when you ADD these two logarithms?

• What happens when you find the antilog of the sum?

**Discussion Questions:**

● How does adding logarithms relate to multiplication?
● How does subtracting logarithms relate to division?
● What operation on logarithms gives you a power?
● What operation on logarithms gives you a root?

**Teacher's Role:** Circulate among groups, asking probing questions. Guide students to discover that $\log(a \times b) = \log(a) + \log(b)$ and $\log(a \div b) = \log(a) - \log(b)$. Use student discoveries to bridge to formal instruction.

### Phase 2: Structured Instruction / Explain (10 minutes)

**Objective:** To formalize the laws of logarithms for multiplication, division, powers, and roots.

**Key Takeaways:**

**The Four Laws of Logarithms for Calculations:**

1. Product Law (Multiplication):

$\log(a \times b) = \log(a) + \log(b)$

To multiply: ADD the logarithms, then find antilog

2. Quotient Law (Division):

$\log(a \div b) = \log(a) - \log(b)$

To divide: SUBTRACT the logarithms, then find antilog

3. Power Law:

$\log(a^b) = b \times \log(a)$

To find a power: MULTIPLY the logarithm by the exponent, then find antilog

4. Root Law:

$\log(\sqrt[n]{a}) = (1/n) \times \log(a)$

To find a root: DIVIDE the logarithm by the root index, then find antilog

**The General Process:**

Step 1: Find log of each number from tables

Step 2: Apply the appropriate operation (+, -, ×, ÷)

Step 3: Find antilog of the result

**Addressing Misconceptions:** "Remember: $\log(a + b) \neq \log(a) + \log(b)$. The laws only work for multiplication, division, powers, and roots - NOT for addition or subtraction!"

## Phase 3: Practice and Application / Elaborate (15 minutes)

**Objective:** To apply logarithm laws to perform calculations.

**Worked Example 1: Multiplication**

Find 236.5 × 42.8 using logarithm tables.

Solution:

Step 1: Find logarithms from tables

$\log(236.5) = 2.3741$

$\log(42.8) = 1.6318$

Step 2: Add the logarithms

   2.3741 + 1.6318 = 4.0059

Step 3: Find antilogarithm

   antilog(4.0059) ≈ 10,160

**Therefore: 236.5 × 42.8 ≈ 10,160**

**Worked Example 2: Division**

Find 528.6 ÷ 24.7 using logarithm tables.

Solution:

Step 1: Find logarithms from tables

   log(528.6) = 2.7233

   log(24.7) = 1.3927

Step 2: Subtract the logarithms

   2.7233 - 1.3927 = 1.3306

Step 3: Find antilogarithm

   antilog(1.3306) ≈ 21.4

**Therefore: 528.6 ÷ 24.7 ≈ 21.4**

**Worked Example 3: Cube Root**

Evaluate $\sqrt[3]{524.8}$ using logarithm tables.

Solution:

Step 1: Find logarithm

   log(524.8) = 2.7200

Step 2: Divide by 3 (cube root)

   2.7200 ÷ 3 = 0.9067

Step 3: Find antilogarithm

   antilog(0.9067) ≈ 8.1

**Therefore: $\sqrt[3]{524.8} \approx 8.1$**

**Teacher's Role:** Monitor students, emphasizing the correct sequence of steps and verifying answers.

## Phase 4: Assessment / Evaluate (Exit Ticket)

**Objective:** To formatively assess individual student understanding.

**Exit Ticket Questions:**

1. Use logarithm tables to evaluate the following:

   a) 345.6 × 78.9

   b) 6284 × 92.5

   c) 0.0482 × 53.7

2. Use logarithms to calculate:

   a) 652.3 ÷ 12.7

   b) 0.0854 ÷ 3.42

   c) 4312 ÷ 58.3

3. Solve the following using logarithms:

   a) $(78.5)^3$

   b) $(254.6)^4$

   c) $(12.75)^{2.5}$

4. Compute the following roots using logarithms:

   a) $\sqrt[3]{658.4}$

   b) $\sqrt{82.6}$

   c) $\sqrt[4]{3126}$

5. A square field has an area of 18,432 square metres. Use logarithms to determine the length of one side.

6. Use logarithm tables to evaluate:

   a) $\sqrt{(4.56 \times 12.3)} \div 24.7$

   b) $\sqrt{(2.718 \times 9.81)} \div (5.432 \times 3.14)$

7. The volume of a cube is 79,507 cubic centimetres. Use logarithms to find the length of one side.

**Answer Key:**

1. Multiplication:

   a) 345.6 × 78.9 ≈ 27,268

   b) 6284 × 92.5 ≈ 581,270

   c) 0.0482 × 53.7 ≈ 2.588

2. Division:

   a) 652.3 ÷ 12.7 ≈ 51.4

   b) 0.0854 ÷ 3.42 ≈ 0.0250

   c) 4312 ÷ 58.3 ≈ 74.0

3. Powers:

   a) $(78.5)^3 ≈ 484,000$

   b) $(254.6)^4 ≈ 4.20 × 10^9$

   c) $(12.75)^{2.5} ≈ 580$

4. Roots:

   a) $\sqrt[3]{658.4} ≈ 8.70$

   b) $\sqrt{82.6} ≈ 9.09$

   c) $\sqrt[4]{3126} ≈ 7.48$

5. Square field:

   Area = 18,432 m², Side = $\sqrt{18,432}$

   log(18432) = 4.2656, ÷ 2 = 2.1328

   antilog(2.1328) ≈ 135.8 metres

7. Cube volume:

   Volume = 79,507 cm³, Side = $\sqrt[3]{79,507}$

   log(79507) = 4.9004, ÷ 3 = 1.6335

antilog(1.6335) ≈ 43.0 cm

## V. Differentiation

| Student Group | Strategy & Activity |
|---|---|
| **Struggling Learners (Support)** | Scaffolding: Provide step-by-step calculation templates. Use color coding for each step. Allow calculator verification. Focus on single operations before combining. |
| **On-Level Learners (Core)** | The core lesson activities as described above. |
| **Advanced Learners (Challenge)** | Extension Activity:<br>1) Evaluate: $\sqrt[4]{\ }$ (8462 × 23.7) ÷ 673<br>2) Evaluate: $\sqrt[3]{}$(6.75 × 432) ÷ 0.89<br>3) Prove: $\log(\sqrt{a} \times \sqrt[3]{b}) = \frac{1}{2}\log(a) + \frac{1}{3}\log(b)$ |

## VI. Assessment

| Type | Method | Purpose |
|---|---|---|
| **Formative (During Lesson)** | - Observation during group work<br>- Questioning during exploration<br>- Exit Ticket | To monitor progress and adjust instruction. |
| **Summative (After Lesson)** | - Homework assignment<br>- Future quiz/test questions | To evaluate mastery of learning objectives. |

## Checkpoint Integration

**Pre-class Preparation list:**

1. Test internet connectivity and access to https://innodems.github.io/CBC-Grade-10-Maths/
2. Ensure all student devices can access the digital textbook
3. Pre-load the checkpoint page on the teacher's display device
4. Have backup printed worksheets in case of technical issues
5. Arrange seating for pair work and station rotations

**Checkpoint protocol for Learners:**

1. Click "Show new example question" to load the problem
2. Solve the displayed question
3. Click "submit" to check your answer

4. If incorrect, carefully read the feedback and analyse the error before trying a new question. The immediate feedback from checkpoint submissions allows students to identify and correct errors in real-time.
5. Complete at least 5 questions before rotating
6. Pair students strategically so stronger learners can explain reasoning to peers.

**Teacher's Role:** Collect and review the exit tickets to gauge student understanding and identify any common misconceptions that need to be addressed in the next lesson.


## VII. Teacher Reflection

*To be completed after the lesson.*

1. What went well?

2. What would I change?

3. Student Understanding: Did students grasp the connection between logarithm operations and arithmetic operations?

4. Next Steps: Which students need more practice with specific operations (multiplication, division, powers, roots)?