

Step by step guide: Multiplying and Dividing Logarithms

Grade 10 Mathematics | 40-Minute Lesson

Before Class Begins

Preparation Checklist:

- Distribute logarithm tables and antilogarithm tables to each student or pair
- Ensure scientific calculators are available for verification
- Display the four laws of logarithms on the board
- Prepare exit tickets for distribution
- Set timer for phase transitions

[WRITE on board before class]:

"LAWS OF LOGARITHMS:

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

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

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

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

PHASE 1: Problem-Solving and Discovery (15 Minutes)

Opening (2 minutes)

[SAY]:

"Good morning/afternoon, class! Before calculators existed, how do you think scientists and engineers performed complex calculations like 236.5×42.8 or finding cube roots?"

[WAIT for responses]

[SAY]:

"They used LOGARITHMS! Today we'll discover how logarithms turn difficult calculations into simple ones."

Anchor Activity Introduction (3 minutes)

[SAY]:

"In your groups, I want you to try a challenge."

Part A: Without a calculator, try to compute:

- 236.5×42.8
- $528.6 \div 24.7$
- The cube root of 524.8

Part B: Now use your logarithm tables. Find $\log(236.5)$ and $\log(42.8)$. What happens when you ADD them and find the antilog?"

Group Work (7 minutes)

[SAY]:

"You have 6 minutes to explore. Discuss with your group:

- *How does adding logarithms relate to multiplication?*
- *How does subtracting relate to division?*
- *What about powers and roots?*

Begin!"

[DO]: Walk around the room, observing group discussions.

[ASK probing questions as you circulate]:

- "What did you get when you added $\log(236.5) + \log(42.8)$?"
- "What's the antilog of that sum? Does it match 236.5×42.8 ?"
- "For the cube root, what operation did you try on the logarithm?"
- "Why do you think adding logs gives multiplication?"

[TIME CHECK]: At 5 minutes, announce: "One more minute!"

Class Discussion (3 minutes)

[SAY]:

"Let's share discoveries. What did you find when you added $\log(236.5) + \log(42.8)$?"

[Expected answer]: " $2.3741 + 1.6318 = 4.0059$, and antilog gives about 10,160!"

[ASK]:

"And $236.5 \times 42.8 = ?$ "

[Expected answer]: "About 10,160! It matches!"

[TRANSITION]:

"Excellent! You've discovered the power of logarithms. Let me formalize these laws."

PHASE 2: Structured Instruction (10 Minutes)

The Four Laws (6 minutes)

[SAY]:

"Logarithms help simplify calculations. Here are the four laws you discovered:"

[WRITE and explain each]:

"LAW 1 - MULTIPLICATION:

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

To multiply: ADD the logarithms, then find antilog

LAW 2 - DIVISION:

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

To divide: SUBTRACT the logarithms, then find antilog

LAW 3 - POWERS:

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

To find a power: MULTIPLY the logarithm by the exponent

LAW 4 - ROOTS:

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

To find a root: DIVIDE the logarithm by the root index"

The Process (2 minutes)

[SAY]:

"The general process is always THREE steps:

Step 1: Find log of each number from tables

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

Step 3: Find antilog of the result"

Misconception Alert (2 minutes)

[SAY - IMPORTANT]:

"CAUTION! A common mistake: $\log(a + b)$ is NOT equal to $\log(a) + \log(b)$!"

The laws ONLY work for:

- *Multiplication \rightarrow add logs*
- *Division \rightarrow subtract logs*
- *Powers \rightarrow multiply log*
- *Roots \rightarrow divide log*

NOT for addition or subtraction of numbers!"

[TRANSITION]:

"Now let's practice using these laws!"

PHASE 3: Practice and Application (15 Minutes)

Worked Example 1: Multiplication (3 minutes)

[SAY]:

"Let's find 236.5×42.8 using logarithm tables."

[WRITE step by step]:

"Step 1: Find logarithms from tables

$$\log(236.5) = 2.3741$$

$$\log(42.8) = 1.6318$$

Step 2: ADD the logarithms (multiplication law)

$$2.3741 + 1.6318 = 4.0059$$

Step 3: Find antilogarithm

$$\text{antilog}(4.0059) \approx 10,160$$

Therefore: $236.5 \times 42.8 \approx 10,160$ "

Worked Example 2: Division (3 minutes)

[SAY]:

"Now let's find $528.6 \div 24.7$ "

[WRITE step by step]:

"Step 1: Find logarithms

$$\log(528.6) = 2.7233$$

$$\log(24.7) = 1.3927$$

Step 2: SUBTRACT the logarithms (division law)

$$2.7233 - 1.3927 = 1.3306$$

Step 3: Find antilogarithm

$$\text{antilog}(1.3306) \approx 21.4$$

Therefore: $528.6 \div 24.7 \approx 21.4$ "

Worked Example 3: Cube Root (3 minutes)

[SAY]:

"Finally, let's find $\sqrt[3]{524.8}$ "

[WRITE step by step]:

"Step 1: Find logarithm

$$\log(524.8) = 2.7200$$

Step 2: DIVIDE by 3 (cube root law)

$$2.7200 \div 3 = 0.9067$$

Step 3: Find antilogarithm

$$\text{antilog}(0.9067) \approx 8.1$$

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

Guided Practice (4 minutes)

[SAY]:

"Try these with your partner:

1. Find 345.6×78.9

2. Find $\sqrt{82.6}$ "

[GIVE 3 minutes, then review]:

"1. 345.6×78.9 :

$$\log(345.6) = 2.5386, \log(78.9) = 1.8971$$

$$\text{Sum} = 4.4357, \text{antilog} \approx 27,268$$

2. $\sqrt{82.6}$:

$$\log(82.6) = 1.9170$$

Divide by 2: 0.9585

antilog ≈ 9.09 "

[TRANSITION]:

"Now I want to see what each of you has learned."

PHASE 4: Assessment / Checkpoint (8 Minutes)

Independent Work (5 minutes)

[DISPLAY questions]:

"1. Use logarithms to find: $652.3 \div 12.7$

2. Use logarithms to find: $\sqrt[3]{658.4}$ "

[SAY]:

"You have 5 minutes. Show all three steps. Begin."

Collection and Closure (2 minutes)

[SAY]:

"Time's up. Please pass your exit tickets forward."

[COLLECT all tickets]

[SAY]:

"Today you learned how logarithms simplify calculations:

- To MULTIPLY: ADD logarithms
- To DIVIDE: SUBTRACT logarithms
- To find POWERS: MULTIPLY the logarithm
- To find ROOTS: DIVIDE the logarithm

Always follow the three steps: find logs, apply operation, find antilog.

Great work today!"

Differentiation Notes

For Struggling Learners:

- Provide step-by-step calculation templates
- Use color coding: log values (blue), operations (green), antilog (red)
- Allow calculator verification of final answers
- Focus on single operations before combining

For Advanced Learners:

[GIVE these extensions]:

- Evaluate: $\sqrt{(4.56 \times 12.3)} \div 24.7$
- Evaluate: $\sqrt[4]{(8462 \times 23.7)} \div 673$
- Prove: $\log(\sqrt{a} \times \sqrt[3]{b}) = \frac{1}{2}\log(a) + \frac{1}{3}\log(b)$

Answer Key

Exit Ticket Answers:

1. $652.3 \div 12.7$:

$$\log(652.3) = 2.8144, \log(12.7) = 1.1038$$

$$2.8144 - 1.1038 = 1.7106$$

$$\text{antilog}(1.7106) \approx 51.4$$

2. $\sqrt[3]{658.4}$:

$$\log(658.4) = 2.8185$$

$$2.8185 \div 3 = 0.9395$$

$$\text{antilog}(0.9395) \approx 8.70$$

Practice Problems Answers:

Multiplication:

$$345.6 \times 78.9 \approx 27,268$$

$$6284 \times 92.5 \approx 581,270$$

$$0.0482 \times 53.7 \approx 2.588$$

Division:

$$652.3 \div 12.7 \approx 51.4$$

$$0.0854 \div 3.42 \approx 0.0250$$

$$4312 \div 58.3 \approx 74.0$$

Powers:

$$(78.5)^3 \approx 484,000$$

$$(254.6)^4 \approx 4.20 \times 10^9$$

$$(12.75)^{2.5} \approx 580$$

Roots:

$$\sqrt[3]{658.4} \approx 8.70$$

$$\sqrt{82.6} \approx 9.09$$

$$\sqrt[4]{3126} \approx 7.48$$

Word Problems:

Square field (Area = 18,432 m²): Side \approx 135.8 m

Cube (Volume = 79,507 cm³): Side \approx 43.0 cm

Post-Lesson Reflection Prompts

- 1. What went well?** Did students discover the laws through exploration?
- 2. What would I change?** Was the table reading clear?
- 3. Student Understanding:** Could students apply the correct law for each operation?
- 4. Next Steps:** Which students need more practice with specific operations?