

Step by step guide: Logarithms Notation

Grade 10 Mathematics | 40-Minute Lesson

Before Class Begins

Preparation Checklist:

- Write the numbers 81, 243, 512, 1000 on the board
- Prepare the conversion formula $a^b = c \leftrightarrow \log_a c = b$ (covered until Phase 2)
- Ensure each group has paper and pen
- Prepare exit tickets for distribution
- Set timer for phase transitions

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

Opening (2 minutes)

[SAY]:

"Good morning/afternoon, class! We've been working with indices—powers like 2^3 and 10^2 . Today, we're going to learn a NEW way to write these same relationships. It's called LOGARITHMS!"

[SAY]:

"Here's our key question: How do we use real numbers in day-to-day activities? Logarithms help us work with very large and very small numbers in science, engineering, and finance."

Anchor Activity Introduction (2 minutes)

[POINT to numbers on board]:

[SAY]:

"Each group will pick one of these numbers: 81, 243, 512, or 1000."

Your task is to:

1. Break down your number into prime factors
2. Write it in index form (like 2^3 or 3^4)
3. Think about this hint: $2^3 = 8$ can be written as $\log_2 8 = 3$

Group Work (8 minutes)

[SAY]:

"Form groups of 2-3. Pick your number and start factoring. You have 6 minutes. Begin!"

[DO]: Walk around the room, observing student work.

[ASK probing questions as you circulate]:

- "What is the smallest prime factor of your number?"
- "How many times did you divide by that prime?"
- "What is your number in index form?"
- "What is the base? What is the exponent?"
- "If $2^3 = 8$ becomes $\log_2 8 = 3$, what would your number become?"

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

Class Discussion (3 minutes)

[SAY]:

"Let's share. Group with 81, what did you find?"

[Expected answer]: " $81 = 3^4$, so $\log_3 81 = 4$ "

[ASK each group and record on board]:

- $81 = 3^4 \rightarrow \log_3 81 = 4$
- $243 = 3^5 \rightarrow \log_3 243 = 5$
- $512 = 2^9 \rightarrow \log_2 512 = 9$
- $1000 = 10^3 \rightarrow \log_{10} 1000 = 3$

[ASK]:

"What pattern do you notice? Where does the exponent go in the logarithm?"

[Expected answer]: "The exponent becomes the answer of the logarithm!"

[TRANSITION]:

"Exactly! Let me show you the formal relationship."

PHASE 2: Structured Instruction (10 Minutes)

The Fundamental Relationship (5 minutes)

[REVEAL formula on board]:

$$a^b = c \leftrightarrow \log_a c = b$$

[SAY]:

"This is the KEY relationship! Logarithms are just another way of writing indices."

In EXPONENTIAL form: $a^b = c$

- *a is the BASE*
- *b is the EXPONENT*
- *c is the RESULT*

In LOGARITHMIC form: $\log_a c = b$

- *a is still the BASE (subscript)*
- *c is the ARGUMENT (inside the log)*
- *b is the ANSWER (the logarithm value)"*

Reading Logarithms (2 minutes)

[SAY]:

"Let's practice reading logarithms:

$\log_2 8 = 3$ is read as: "logarithm of 8 to base 2 equals 3"

It answers the question: "2 to what power equals 8?"

Answer: 3, because $2^3 = 8$ "

More Examples (2 minutes)

[WRITE and SAY]:

"Let's convert more examples:

- $2^2 = 4 \rightarrow \log_2 4 = 2$
- $10^2 = 100 \rightarrow \log_{10} 100 = 2$
- $5^3 = 125 \rightarrow \log_5 125 = 3$ "

Addressing Misconceptions (1 minute)

[SAY - IMPORTANT]:

"Remember:

- *The BASE stays the same (it becomes the subscript)*
- *The RESULT goes inside the log (becomes the argument)*
- *The EXPONENT becomes the answer*

The logarithm IS the exponent!"

[TRANSITION]:

"Now let's practice converting between forms!"

PHASE 3: Practice and Application (15 Minutes)

Guided Practice (5 minutes)

[SAY]:

"Let's convert these to logarithmic form together."

[PROBLEM 1]:

" $6^2 = 36$. What is the logarithmic form?"

[WAIT, then solve]:

"Base is 6, result is 36, exponent is 2.

So: $\log_6 36 = 2$ "

[PROBLEM 2]:

" $9^3 = 729$. Convert to logarithmic form."

[Expected answer]: " $\log_9 729 = 3$ "

Evaluating Logarithms (4 minutes)

[SAY]:

"Now let's evaluate some logarithms. What is $\log_{10}(10)$?"

[EXPLAIN]:

"We ask: 10 to what power equals 10?"

$10^1 = 10$, so $\log_{10}(10) = 1$ "

[SAY]:

"What about $\log_{10}(0.001)$?"

$$0.001 = 1/1000 = 10^{-3}$$

$$\text{So } \log_{10}(0.001) = -3"$$

Partner Practice (6 minutes)

[SAY]:

"Work with your partner:

a) Convert $4^5 = 1024$ to logarithmic form

b) If $\log_2 x = 5$, find x

c) Find y if $\log_y 81 = 4$ "

[GIVE 5 minutes, then review]:

$$\text{"a) } \log_4 1024 = 5$$

$$\text{b) } \log_2 x = 5 \text{ means } 2^5 = x, \text{ so } x = 32$$

$$\text{c) } \log_y 81 = 4 \text{ means } y^4 = 81, \text{ so } y = 3"$$

[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. Write the logarithmic form of $2^6 = 64$

2. Solve for x if $\log_2 x = 5$

3. Convert $8^x = 512$ to logarithmic form"

[SAY]:

"You have 5 minutes. Begin."

Collection and Closure (2 minutes)

[SAY]:

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

[COLLECT all tickets]

[SAY]:

"Today you learned:

- *Logarithms are another way of writing indices*
- *$a^b = c$ converts to $\log_a c = b$*
- *The logarithm IS the exponent*
- *Logarithms answer: "What power gives this result?"*

[SAY]:

"Great work today! For homework, complete the remaining problems from the assessment sheet."

Differentiation Notes

For Struggling Learners:

- Provide conversion templates showing $a^b = c \leftrightarrow \log_a c = b$
- Use color coding (base in red, exponent in blue, result in green)
- Start with base 10 and base 2 examples
- Allow reference cards during practice

For Advanced Learners:

[GIVE these extensions]:

- Evaluate $\log_2(1/8)$ and explain why the answer is negative
- If $\log_3 x = 4$ and $\log_3 y = 2$, find $\log_3(xy)$
- Research how logarithms are used in the Richter scale or decibels

Answer Key

Exit Ticket Answers:

1. $2^6 = 64$: $\log_2 64 = 6$

2. $\log_2 x = 5$: $x = 2^5 = 32$

3. $8^x = 512$: $\log_8 512 = x$; since $8^3 = 512$, $x = 3$

Additional Assessment Answers:

$\log_8 4096 = 4$

$$\log_5 125 = 3$$

$$\log_6 216 = y \text{ (where } 6^y = 216, \text{ so } y = 3)$$

$$\log_3 81 = x \text{ (where } 3^x = 81, \text{ so } x = 4)$$

$$\log_{10} 10000 = 4$$

$$\log_y 81 = 4 \rightarrow y = 3$$

Post-Lesson Reflection Prompts

- 1. What went well?** Did the prime factorization activity help students see the connection?
- 2. What would I change?** Was the conversion formula clear enough?
- 3. Student Understanding:** Did students correctly identify base, exponent, and result?
- 4. Next Steps:** Which students need more practice with the conversion?