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]:

• $81 = 3^4 \longrightarrow \log_3 81 = 4$

• $243 = 3^5 \longrightarrow \log_3 243 = 5$

• $512 = 2^9 \longrightarrow \log_2 512 = 9$

• $1000 = 10^3 \longrightarrow \log_{10} 1000 = 3$

[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 $\log_{10}(0.001)$?
$0.001 = 1/1000 = 10^{-3}$
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]:

"a) $\log_4 1024 = 5$
b) $\log_2 x = 5$ means $2^5 = x$, so $x = 32$
c) $\log_y 81 = 4$ means $y^4 = 81$, 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:

$\log_8 4096 = 4$

$\log_5 125 = 3$

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

$\log_3 81 = x$ (where $3^x = 81$, 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?