I. Lesson Overview

Lesson Title:	Logarithms Notation
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 are another way of expressing indices, and recognize the relationship between exponential and logarithmic notation.
2. **Do (Procedural Skill):** Convert expressions between exponential form ($a^b = c$) and logarithmic form ($\log_a c = b$).
3. **Apply (Application/Problem-Solving):** Apply logarithmic notation to solve problems involving exponential relationships in real-world contexts.

Curriculum Alignment

Strand:	Numbers and Algebra
Sub-Strand:	Indices and Logarithms
Specific Learning Outcome:	Determining the logarithms notation of numbers.

III. Materials & Resources

Textbooks:	CBC Grade 10 Mathematics Learner's Book CBC Grade 10 Mathematics Teacher's Book
Materials:	Paper/book and pen for each group

IV. Lesson Procedure

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

Objective: To explore the connection between indices and logarithms through prime factorization.

Anchor Activity: Prime Factorization and Index Form

Work in Groups of 2-3:

Materials: Paper/book and pen

Instructions:

4. Pick a number from the set: 81, 243, 512, or 1000
5. Break down the chosen number into its prime factors by dividing repeatedly by the smallest prime factor
6. Express your final result in index form
7. Reflect on how the indices relate to logarithms

Example to Guide Students:

$2^3 = 8$ translates to $\log_2 8 = 3$

The exponent (3) becomes the logarithm value!

Expected Discoveries:

Number	Index Form	Logarithmic Form
81	3^4	$\log_3 81 = 4$
243	3^5	$\log_3 243 = 5$
512	2^9	$\log_2 512 = 9$
1000	10^3	$\log_{10} 1000 = 3$

Teacher's Role: The teacher circulates among groups, asking probing questions (e.g., "What is the base in your index form?", "What is the exponent?", "How does the exponent relate to the logarithm?"). The teacher uses student discoveries to bridge to formal instruction.

Phase 2: Structured Instruction / Explain (10 minutes)

Objective: To formalize the relationship between exponential and logarithmic notation.

Key Takeaways:

What is a Logarithm?

Logarithms are simply another way of expressing indices. They bridge the gap between exponential and logarithmic notation.

The Fundamental Relationship:

Exponential Form (Index Notation)	Logarithmic Form (Logarithmic Notation)
$a^b = c$	$\log_a c = b$
Base^Exponent = Result	log_Base(Result) = Exponent

Examples:

- $2^3 = 8 \rightarrow \log_2 8 = 3$ (read as: "logarithm of 8 to base 2 equals 3")
- $2^2 = 4 \rightarrow \log_2 4 = 2$
- $2^1 = 2 \rightarrow \log_2 2 = 1$
- $10^2 = 100 \rightarrow \log_{10} 100 = 2$

Key Insight:

The logarithm answers the question: "What power must I raise the base to, in order to get this number?"

$\log_2 8 = ?$ asks "2 to what power equals 8?" Answer: 3

Addressing Misconceptions: "Remember: In $\log_a c = b$, the BASE stays the same (a), the RESULT becomes the argument (c), and the EXPONENT becomes the answer (b). The logarithm IS the exponent!"

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

Objective: To apply the conversion between exponential and logarithmic forms.

Worked Examples:

1. Convert to logarithmic form:

   a) $6^2 = 36 \rightarrow \log_6 36 = 2$

   b) $9^3 = 729 \rightarrow \log_9 729 = 3$

   c) $4^5 = 1024 \rightarrow \log_4 1024 = 5$

2. Evaluate the following:

   a) $\log_{10}(10) = \log_{10}(10^1) = 1$

   b) $\log_{10}(0.001) = \log_{10}(10^{-3}) = -3$

c) $\log_{10}(10^{25}) = 25$

Real-World Application:

3. During a simulation, a machine amplifies a signal using exponential growth. After several cycles, the signal reaches a strength of 64, generated using base 4.

Write the logarithmic form of: $4^3 = 64$

Solution: $\log_4 64 = 3$

Teacher's Role: The teacher monitors students, emphasizing the pattern: base stays the same, result goes inside the log, exponent becomes the answer.

Phase 4: Assessment / Evaluate (Exit Ticket)

Objective: To formatively assess individual student understanding.

Exit Ticket Questions:

1. Write the logarithmic form of:

a) $2^6 = 64$

b) $8^4 = 4096$

c) $5^3 = 125$

d) $6^y = 216$

e) $3^x = 81$

2. Express $10^4 = 10000$ in logarithmic form.

3. Find the value of y given that $\log_y 81 = 4$

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

5. Convert $8^x = 512$ to logarithmic form and solve for x

Answer Key:

1. a) $\log_2 64 = 6$

b) $\log_8 4096 = 4$

c) $\log_5 125 = 3$

d) $\log_6 216 = y$

e) $\log_3 81 = x$

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

3. $\log_y 81 = 4$ means $y^4 = 81$, so $y = 3$ (since $3^4 = 81$)

4. $\log_2 x = 5$ means $2^5 = x$, so $x = 32$

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

V. Differentiation

Student Group	Strategy & Activity
Struggling Learners (Support)	Scaffolding: 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.
On-Level Learners (Core)	The core lesson activities as described above.
Advanced Learners (Challenge)	Extension Activity: 1) Evaluate $\log_2(1/8)$ and explain why the answer is negative. 2) If $\log_3 x = 4$ and $\log_3 y = 2$, find $\log_3(xy)$. 3) Research: How are logarithms used in measuring earthquake intensity (Richter scale) or sound (decibels)?

Extension Activity Solutions:

1. $\log_2(1/8) = \log_2(2^{-3}) = -3$

   (The answer is negative because 1/8 is less than 1)

2. $\log_3(xy) = \log_3 x + \log_3 y = 4 + 2 = 6$

   (Using the product rule of logarithms)

VI. Assessment

Type	Method	Purpose
Formative (During Lesson)	- Observation during prime factorization - Questioning during exploration - Exit Ticket	To monitor progress and adjust instruction.

Summative (After Lesson)	- Homework assignment - Future quiz/test questions	To evaluate mastery of learning objectives.

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: What did the exit tickets reveal?

4. Next Steps: Based on assessment data, what is the plan for the next lesson?