CBC Grade 10 Mathematics

Step-by-Step Presentation Script

Logarithms of Powers and Roots

Pre-Class Preparation

Before students arrive, ensure the following materials and setup are ready:

- Materials Needed:
- • Scientific calculators (one per student or pair)
- • Logarithm tables (printed copies)
- • Chart paper for displaying formulas
- • Markers
- • Exit tickets (one per student)
- Classroom Setup:
- • Arrange desks for group work (groups of 2-3 students)
- • Prepare board space for formulas and worked examples
- • Display key inquiry question: "How do we use real numbers in day-to-day activities?"
- • Have logarithm tables accessible for all students

Lesson Overview (40 Minutes)

Phase	Duration
Phase 1: Problem-Solving and Discovery	0-15 minutes
Phase 2: Structured Instruction	15-25 minutes
Phase 3: Practice and Application	25-37 minutes
Phase 4: Assessment (Exit Ticket)	37-40 minutes

Minute-by-Minute Presentation Guide

Minutes 0-2: Introduction and Engagement

[SAY] "Good morning, class! Today we explore how logarithms help us work with powers and roots. You've learned about indices and basic logarithms. Now we'll discover how to use logarithms to calculate large powers and roots without tedious multiplication."

[ASK] "Who can remind us: What is a logarithm?"

[LISTEN] Expected answer: A logarithm tells us the power to which a base must be raised to get a number.

[SAY] "Excellent! Today you'll discover that logarithms turn difficult power and root calculations into simple multiplication and division."

[WRITE] On the board: "Logarithms of Powers and Roots"

[WRITE] Key inquiry question: "How do we use real numbers in day-to-day activities?"

Minutes 2-17: Phase 1 - Anchor Activity (Discovery)

[DO] Organize students into groups of 2-3.

[SAY] "You will explore logarithms using your calculators. This investigation will help you discover important patterns."

[DO] Distribute calculators to each group.

[WRITE] Display the anchor activity instructions:

"Use your calculator to solve: log(10000)"

[SAY] "Work together. First, calculate log(10000) using your calculator."

[DO] Allow 1 minute for calculation.

[ASK] "What did you get?"

[LISTEN] Students should say: 4

[SAY] "Good! Now, can you rewrite 10000 as a power of 10?"

[LISTEN] Expected: $10000 = 10^4$

[WRITE] "$10000 = 10^4$, so $\log(10000) = \log(10^4)$"

[SAY] "Notice something interesting: $\log(10^4) = 4$. The exponent 4 became our answer. Let's explore this pattern."

[WRITE] "Try these: log(100), log(1000000), $\log(\sqrt{100})$, $\log(\sqrt[3]{1000})$"

[DO] Circulate among groups (Minutes 4-12). Observe their work and ask probing questions:

- • "What pattern do you notice with the exponents?"
- • "How does $\log(\sqrt{100})$ relate to log(100)?"
- • "Can you express $\sqrt{100}$ as a power?"
- • "What general rule can you form?"

[TEACHING TIP] Guide students to recognize: $\sqrt{100} = 100^{(1/2)}$, so $\log(\sqrt{100}) = (1/2) \times \log(100)$

[DO] At minute 12, bring the class together for sharing.

[SAY] "Let's discuss what you discovered. Group 1, what did you notice about log(100)?"

[LISTEN] Expected: $\log(100) = 2$, because $100 = 10^2$

[SAY] "And what about $\log(\sqrt{100})$?"

[LISTEN] Expected: $\log(\sqrt{100}) = 1$, which is half of $\log(100)$

[SAY] "Excellent observation! You've discovered the power law of logarithms. Let's formalize this."

Minutes 17-25: Phase 2 - Structured Instruction

[SAY] "You discovered that when we take the logarithm of a power, the exponent comes down as a multiplier. This is the power law of logarithms."

[WRITE] "Power Law of Logarithms"

[WRITE] $\log(a^b) = b \times \log(a)$

[SAY] "This law says: the logarithm of a number raised to a power equals the power times the logarithm of the number."

[EXAMPLE] "For instance: $\log(2^3) = 3 \times \log(2)$"

[WRITE] "Examples:"

- • $\log(10^4) = 4 \times \log(10) = 4 \times 1 = 4$
- • $\log(5^6) = 6 \times \log(5)$

[SAY] "Now, what about roots? Remember that roots are fractional powers."

[WRITE] "Roots as Fractional Powers:"

- $\sqrt{a} = a^{(1/2)}$
- $\sqrt[3]{a} = a^{(1/3)}$

[SAY] "So when we apply the power law to roots:"

[WRITE] $\log(\sqrt{a}) = \log(a^{(1/2)}) = (1/2) \times \log(a)$

[WRITE] $\log(\sqrt[3]{a}) = \log(a^{(1/3)}) = (1/3) \times \log(a)$

[EXAMPLE] "Let's verify with our earlier discovery:"

[WRITE] $\log(\sqrt{100}) = (1/2) \times \log(100) = (1/2) \times 2 = 1$ ✓

[SAY] "This law is powerful because it lets us calculate large powers and roots using logarithm tables instead of tedious multiplication."

[TEACHING TIP] Create a visual showing how the exponent "comes down" as a multiplier.

Minutes 25-37: Phase 3 - Practice and Application

[SAY] "Now let's apply this law to solve real problems using logarithm tables."

[EXAMPLE] Example 1: Evaluating $(23.5)^4$

[WRITE] "Evaluate $(23.5)^4$ using logarithm tables."

[SAY] "This would be very difficult to calculate by hand. Let's use logarithms."

[WRITE] Step 1: Let $x = (23.5)^4$, then $\log(x) = \log((23.5)^4)$

[SAY] "Now we apply the power law."

[WRITE] Step 2: $\log(x) = 4 \times \log(23.5)$

[SAY] "Find log(23.5) from your logarithm table."

[DO] Give students 30 seconds to find the value.

[WRITE] Step 3: $\log(23.5) = 1.3711$

[SAY] "Now multiply by 4."

[WRITE] Step 4: $\log(x) = 4 \times 1.3711 = 5.4844$

[SAY] "Finally, we find the antilogarithm to get our answer."

[WRITE] Step 5: $x = \text{antilog}(5.4844) = 304{,}000$

[SAY] "So $(23.5)^4 = 304{,}000$. Notice how logarithms turned a difficult power into simple multiplication!"

[EXAMPLE] Example 2: Finding $\sqrt[3]{524.8}$

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

[SAY] "Cube roots are also difficult by hand. Let's use logarithms."

[WRITE] Step 1: $\sqrt[3]{524.8} = (524.8)^{(1/3)}$

[SAY] "We express the cube root as a fractional power."

[WRITE] Step 2: $\log(\sqrt[3]{524.8}) = \log((524.8)^{(1/3)})$

[WRITE] Step 3: $\log(\sqrt[3]{524.8}) = (1/3) \times \log(524.8)$

[SAY] "Find log(524.8) from your table."

[WRITE] Step 4: $\log(524.8) = 2.7200$

[SAY] "Now divide by 3."

[WRITE] Step 5: $\log(\sqrt[3]{524.8}) = 2.7200 \div 3 = 0.9067$

[WRITE] Step 6: $\sqrt[3]{524.8} = \text{antilog}(0.9067) = 8.065$

[SAY] "The cube root of 524.8 is approximately 8.065."

[EXAMPLE] Example 3: Computing $(78.5)^3$

[WRITE] "Compute $(78.5)^3$ using logarithms."

[SAY] "Let's do this one more quickly. What's our first step?"

[LISTEN] Students should suggest: Apply the power law.

[WRITE]

- $\log((78.5)^3) = 3 \times \log(78.5)$
- $= 3 \times 1.8949 = 5.6847$
- $(78.5)^3 = \text{antilog}(5.6847) \approx 484{,}000$

[DO] Give students 7 minutes (minutes 30-37) to work on individual practice:

1. 1. Evaluate $(12.4)^5$ using logarithms
2. 2. Find $\sqrt{2500}$ using logarithms
3. 3. Calculate $(254.6)^4$ using logarithms

[DO] Circulate to check understanding and provide support.

Minutes 37-40: Phase 4 - Assessment (Exit Ticket)

[SAY] "Excellent work today! To check your understanding, complete this exit ticket individually."

[DO] Distribute exit tickets.

[SAY] "You have 3 minutes. Show all your work using the power law."

[WRITE] Display exit ticket questions:

4. 1. The volume of a cube is 79,507 cm^3. Use logarithms to find the side length.
5. 2. Compute $(78.5)^3$ using logarithms.
6. 3. Compute $(254.6)^4$ using logarithms.

[DO] Students work silently (minutes 37-40).

[DO] Collect exit tickets.

[SAY] "Great work today! You now know how to use logarithms to calculate powers and roots efficiently. This skill is used in science, engineering, and finance. For homework, find one real-world example where calculating large powers or roots is necessary."

Teaching Tips and Strategies

Emphasis Points:

- • The exponent "comes down" as a multiplier: $\log(a^b) = b \times \log(a)$
- • Roots are fractional powers: $\sqrt{a} = a^{(1/2)}$, $\sqrt[3]{a} = a^{(1/3)}$
- • Logarithms turn multiplication into addition, powers into multiplication
- • Always find antilog at the end to get the final answer
- • Use logarithm tables systematically: characteristic + mantissa

Differentiation in Action:

- • For struggling learners: Provide step-by-step formula cards, start with powers of 10
- • For advanced learners: Combine power law with product/quotient laws
- • Use visual aids showing the power law
- • Allow extra time for calculator and table practice

Common Student Errors:

- • Forgetting to apply the power law (trying to find log of the entire power)
- • Confusing roots with division instead of fractional powers
- • Not converting roots to fractional exponents first
- • Forgetting to find the antilogarithm at the end
- • Misreading logarithm tables

Engagement Strategies:

- • Use real-world contexts (engineering calculations, scientific notation)
- • Show historical importance of logarithm tables before calculators
- • Connect to previous knowledge of indices
- • Demonstrate calculator vs. tables comparison

Assessment Guidance

Exit Ticket Evaluation Criteria:

- • Correct application of power law: $\log(a^b) = b \times \log(a)$
- • Proper conversion of roots to fractional powers
- • Accurate use of logarithm tables
- • Correct calculation of antilogarithm
- • Clear working shown with all steps

Mastery Indicators:

- • Student can apply $\log(a^b) = b \times \log(a)$ correctly
- • Student can convert roots to fractional powers
- • Student can use logarithm tables accurately
- • Student can find antilogarithms correctly

Follow-Up for Students Who Struggle:

- • Provide additional practice with simple powers of 10
- • Create step-by-step reference cards
- • Use visual aids showing the power law
- • Schedule small group intervention for table reading

Post-Lesson Reflection Questions

After teaching this lesson, reflect on:

- • Did students successfully apply the power law?
- • Were students able to convert roots to fractional powers?
- • What misconceptions emerged?
- • How comfortable were students using logarithm tables?
- • Did the anchor activity effectively introduce the concept?
- • What percentage demonstrated mastery on the exit ticket?
- • What adjustments would improve this lesson?