Step by step guide: Determining Common Logarithms Using Mathematical Tables and Calculators

Grade 10 Mathematics | 40-Minute Lesson

Before Class Begins

Preparation Checklist:

- Distribute logarithm tables to each student or pair
- Ensure scientific calculators are available
- Display a sample logarithm table on the board/projector
- Prepare exit tickets for distribution
- Set timer for phase transitions
- Write the structure: Characteristic + Mantissa on the board

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

Opening (2 minutes)

[SAY]:

"Good morning/afternoon, class! Today we're going to learn how to use LOGARITHM TABLES and CALCULATORS to find common logarithms. This is a practical skill that scientists and engineers use every day!"

[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 efficiently."

Anchor Activity Introduction (3 minutes)

[DO]: Distribute logarithm tables to students.

[SAY]:

"Take a moment to examine your logarithm table. In your groups, I want you to explore:

Part A: Understanding the Table Structure
1. What do you notice about the table's structure?
2. Identify the first column, the columns labeled 0-9, and the Mean Difference columns
3. What do you think each part represents?

Part B: Finding Logarithms
Try to find: log(47), log(473), log(4.73), and log(0.0473)"

Group Work (7 minutes)

[SAY]:

"As you work, discuss:
• How does the position of the decimal point affect the logarithm?
• What pattern do you notice between log(47), log(473), and log(4.73)?
• How do you handle numbers less than 1?

You have 6 minutes. Begin!"

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

[ASK probing questions as you circulate]:

- "What happens to the logarithm when you multiply the number by 10?"
- "How do you read the mantissa for a 3-digit number?"
- "What do you think the Mean Difference columns are for?"
- "How is log(0.0473) different from log(473)?"

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

Class Discussion (3 minutes)

[SAY]:

"Let's share what you discovered. What did you notice about the table structure?"

[Expected answers]:

- "The first column has numbers from 10 to 99."
- "The columns 0-9 give decimal values."
- "The Mean Difference helps with the fourth digit."

[ASK]:

"What pattern did you notice between log(47), log(473), and log(4.73)?"

[Expected answer]: "The decimal part (mantissa) is the same, but the integer part (characteristic) changes!"

[TRANSITION]:

"Excellent observation! Let me formalize this."

PHASE 2: Structured Instruction (10 Minutes)

Structure of a Logarithm (3 minutes)

[SAY]:

"Every common logarithm has TWO parts:

1. CHARACTERISTIC: The integer part - determined by where the decimal point is
2. MANTISSA: The decimal part - found from the logarithm table"

[WRITE on board]:

"log(number) = Characteristic + Mantissa"

Finding the Characteristic (3 minutes)

[SAY]:

"For numbers GREATER than or equal to 1:
Characteristic = (number of digits before decimal) − 1

Example: 472.8 has 3 digits before the decimal
So characteristic = 3 − 1 = 2"

[SAY]:

"For numbers LESS than 1:
Characteristic = −(number of zeros after decimal + 1)

Example: 0.00534 has 2 zeros after the decimal
So characteristic = −(2 + 1) = −3
We write this as $\bar{3}$ (three bar)"

Finding the Mantissa (3 minutes)

[SAY]:

"The 5-Step Process for finding the mantissa:

Step 1: Write the number in standard form
Step 2: Locate the first two digits in the first column
Step 3: Move across to the column for the third digit
Step 4: Add the mean difference for the fourth digit
Step 5: Combine characteristic + mantissa"

[SAY - IMPORTANT]:

"Remember: The mantissa is ALWAYS positive. Only the characteristic can be negative!"

[TRANSITION]:

"Now let's practice finding logarithms step by step!"

PHASE 3: Practice and Application (15 Minutes)

Worked Example 1 (4 minutes)

[SAY]:

"Let's find log(472.8) using the logarithm table."

[WRITE step by step]:

"Step 1: Standard form: 4.728×10^2

Step 2: Characteristic = 2 (since $10^2 \leq 472.8 < 10^3$)

Step 3: Find mantissa - Locate 47 in first column, move to column 2
Read: 0.6749

Step 4: Mean difference for 8 = 0.0007
Mantissa = 0.6749 + 0.0007 = 0.6756

Step 5: Combine: log(472.8) = 2.6756"

[SAY]:

"Let's verify with a calculator... $\log(472.8) \approx 2.6746$. Very close!"

Worked Example 2 (4 minutes)

[SAY]:

"Now let's find log(0.00534) - a number less than 1."

[WRITE step by step]:

"Step 1: Standard form: 5.34×10^{-3}

Step 2: Characteristic = −3 (written as $\bar{3}$)
(Two zeros after decimal, so −(2+1) = −3)

Step 3: Find mantissa - Locate 53 in first column, move to column 4
Read: 0.7275

Step 4: Combine: log(0.00534) = $\bar{3}$.7275"

[SAY - IMPORTANT]:

"Notice the bar over the 3. This means the characteristic is −3, but the mantissa 0.7275 is still positive!"

Guided Practice (5 minutes)

[SAY]:

"Try these with your partner:
a) Find log(3140)
b) Find log(0.00893)"

[GIVE 4 minutes, then review]:

"a) log(3140):
- *Standard form: 3.14×10^{3}*
- *Characteristic: 3*
- *Mantissa: 0.4969 (from 31, column 4)*
- *Answer: 3.4969*

b) log(0.00893):
- *Standard form: 8.93×10^{-3}*
- *Characteristic: $\bar{3}$ (negative 3)*
- *Mantissa: 0.9509 (from 89, column 3)*
- *Answer: $\bar{3}$.9509"*

[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. Express in standard form: 4820, 0.000485
2. Find using log tables: log(52.7), log(0.000245)"

[SAY]:

"You have 5 minutes. Show your work. Begin."

Collection and Closure (2 minutes)

[SAY]:

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

[COLLECT all tickets]

[SAY]:

"Today you learned to find common logarithms using tables:
• Every logarithm has a CHARACTERISTIC (integer) and MANTISSA (decimal)
• For numbers ≥ 1: Characteristic = digits before decimal − 1
• For numbers < 1: Characteristic is negative (use bar notation)
• The mantissa comes from the table and is ALWAYS positive

Great work today!"

Differentiation Notes

For Struggling Learners:

- Provide step-by-step guides with the 5-step process
- Use highlighted logarithm tables
- Allow calculator verification at each step
- Pair with stronger students

For Advanced Learners:

[GIVE these extensions]:

- Find log(0.000003456) and verify with calculator

- If log(x) = 2.5453, find x using antilogarithms
- Use logarithms to calculate: (472.8 × 0.00534) ÷ 3140
- Research: How are logarithms used in the Richter scale?

Answer Key

Standard Form Answers:

a) $4820 = 4.82 \times 10^{3}$

b) $37.6 = 3.76 \times 10^{1}$

c) $672000 = 6.72 \times 10^{5}$

d) $321000 = 3.21 \times 10^{5}$

e) $0.000485 = 4.85 \times 10^{-4}$

f) $91800 = 9.18 \times 10^{4}$

g) 5.27×10^{5} (already in standard form)

h) $0.000672 = 6.72 \times 10^{-4}$

Logarithm Answers:

a) $\log(0.00893) = \bar{3}.9509$

b) $\log(0.000245) = \bar{4}.3892$

c) $\log(3140) = 3.4969$

d) $\log(6420) = 3.8075$

e) $\log(52.7) = 1.7218$

f) $\log(78900) = 4.8971$

g) $\log(0.000978) = \bar{4}.9903$

Post-Lesson Reflection Prompts

1. What went well? Did students correctly identify characteristics?

2. What would I change? Was the bar notation clear?

3. Student Understanding: Could students read the mantissa accurately?

4. Next Steps: Which students need more practice with numbers < 1?