

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]:

" $\log(\text{number}) = \text{Characteristic} + \text{Mantissa}$ "

Finding the Characteristic (3 minutes)

[SAY]:

"For numbers GREATER than or equal to 1:

$\text{Characteristic} = (\text{number of digits before decimal}) - 1$

Example: 472.8 has 3 digits before the decimal

So characteristic = $3 - 1 = 2$ "

[SAY]:

"For numbers LESS than 1:

$\text{Characteristic} = -(\text{number of zeros after decimal} + 1)$

Example: 0.00534 has 2 zeros after the decimal

So characteristic = $-(2 + 1) = -3$

We write this as $3\overline{)}(three\ bar)$ "

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 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: $\log(0.00534) = \underline{3}.7275$ "

[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: $\underline{3}$ (negative 3)
- Mantissa: 0.9509 (from 89, column 3)
- Answer: $\underline{3}.9509$ "

[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: $(472.8 \times 0.00534) \div 3140$
- 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) $\log(0.00893) = 3.9509$
b) $\log(0.000245) = 4.3892$
c) $\log(3140) = 3.4969$
d) $\log(6420) = 3.8075$
e) $\log(52.7) = 1.7218$
f) $\log(78900) = 4.8971$
g) $\log(0.000978) = 4.9903$

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?