Office Hours!

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Finding the log of any number

(1) Write the number as $10^n \times$(number between 1 and 10)

(2) Find the log of the number between 1 and 10 using table or graph

(3) Log is $n + \log$(number between 1 and 10)

Example: Find $\log(573)$

(1) $\log(573) = \log(100 \times 5.73) = \log(100) + \log(5.73) = 2 + \log(5.73)$

(2) $\boxed{\log(5.73) \approx 0.7582}$

(3) $\log(573) \approx 2 + 0.7582 = 2.7582$

Find $\log(57.3)$

A≈ 7.582 B$\approx 10 + 0.7582$ C$\approx 1 + 0.7582$ D Other $\boxed{\text{C}}$

Find $\log(0.573)$

A≈ -1.7582 B$\approx -1 + 0.7582$ C≈ -0.7582 D Other $\boxed{\text{B}}$

Finding the antilog of any number

Example: 2.306 is not on x-axis of graph $y = 10^x$ or in middle of log table. So how do you use table or graph to find antilog(2.306)?

Think about it:
$$\begin{aligned} \text{antilog}(2.306) &= 10^{2.306} \\ &= \underbrace{10^{2}}_{\text{duh!}} \times \underbrace{10^{0.306}}_{\text{look it up!}} \\ &\approx 100 \times 2.02 \\ &= 202 \end{aligned}$$

This is like the moving decimal point trick for logs.

From log table: $10^{0.86} \approx 7.25$. Use this to find antilog(3.86)

$\boxed{\approx 7250}$

A= I got it right B= I was close C= I was wrong

§7.5: Using logs to multiply

First rule of logs: $\log(a \times b) = \log(a) + \log(b)$

Example: Find 2.7×1.6 using logs
Hint: $\log(2.7) \approx 0.43$ and $\log(1.6) \approx 0.20$

Method
(i) Look up $\log(2.7)$ and $\log(1.6)$
(ii) Add these
(iii) Take the antilog of result from (ii)
(iv) Think: Is the answer reasonable or did I goof up?

A= done B= confused

§7.5: Using logs to multiply

First rule of logs: $\log(a \times b) = \log(a) + \log(b)$

Example: Find 2.7×1.6 using logs
Hint: $\log(2.7) \approx 0.43$ and $\log(1.6) \approx 0.20$

Look how I write the answer.

- $\log(2.7 \times 1.6) = \log(2.7) + \log(1.6)$
- Look up $\log(2.7) \approx 0.43$ and $\log(1.6) \approx 0.20$, so $\log(2.7 \times 1.6) \approx 0.43 + 0.20 = 0.63$
- Is this the answer ? Heck No! It is the log of the answer
- $2.7 \times 1.6 \approx \text{antilog}(0.63) = 10^{0.63}$
- Look up $10^{0.63} \approx 4.3$
- Is my answer $\boxed{4.3}$ reasonable? Yes, about $2 \times 2 = 4$.

A Really Bad Answer

$2.7 \times 1.6 \quad \log(2.7 \times 1.6) \qquad \log(2.7) + \log(1.6)$

$\qquad\qquad\qquad\qquad\qquad\qquad = 0.43 \quad = 0.20$

$0.43 + 0.20 = 0.63 \longleftarrow$ my answer!!

Common mistake: Writing math so badly it is not even wrong*.

Stare at what is written does it make any sense?

The answer can't be right: how can 2.7×1.6 be 0.43?

Where is the mistake? It is so badly written that there is no mistake to find because it is nonsense.

* "Not even wrong" is due to the physicist Wolfgang Pauli.

Summary of Good Advice

- Write your work properly.
- Eat your fruit & vegetables
- Exercise regularly
- Get enough sleep
  [This advice brought to you by your mother]

Examples:

Example: Find 352×17.7 using logs and tables.

Hint: $\log(3.52) \approx 0.5465$ and $\log(1.77) \approx 0.2480$

A= done B= I'm working! C= confused

My Steps:

(1) $\log(352) = 2 + \log(3.52) \approx 2.5465$ (move the decimal point)

(2) $\log(17.7) = 1 + \log(1.77) \approx 1.2480$ (move the decimal point)

(3) Add:
$\log(352 \times 17.7) = \log(352) + \log(17.7) \approx 2.5465 + 1.2480 = 3.7945$

(4) So:
$352 \times 17.7 \approx \text{antilog}(3.7945) = 10^{3.7945} = 10^3 \times 10^{0.7945} \approx 6230$

(5) Check: Is this reasonable? Should be about $300 \times 20 = 6000$

Did you get close?

A = Yes B = No C = Didn't finish

§7.5: Using logs to divide

Remember Log Rule (5): $\boxed{\log(a \div b) = \log(a) - \log(b)}$

Example: Use this rule to find 38.2/1.77
Hint: $\log(3.82) \approx 0.58$ and $\log(1.77) \approx 0.25$

Method
(i) Look up $\log(3.82)$ and $\log(1.77)$, find $\log(38.2)$
(ii) Subtract!
(iii) Take the antilog of result from (ii)
(iv) Think: Is the answer reasonable or did I goof up?

A= done B= confused

§7.5: Using logs to divide

Remember Log Rule (5): $\boxed{\log(a \div b) = \log(a) - \log(b)}$

Example: Use this rule to find 38.2/1.77
Hint: $\log(3.82) \approx 0.58$ and $\log(1.77) \approx 0.25$

Look how I write the answer.

- $\log(38.2 \div 1.77) = \log(38.2) - \log(1.77)$ using $\log(a/b) = \log(a) - \log(b)$
- $\log(38.2) = 1 + \log(3.82) \approx 1.58$ from graph and move decimal point
- $\log(1.77) \approx 0.25$ from graph
- $\log(38.2) - \log(1.77) \approx 1.58 - 0.25 = 1.33$
- Therefore $38.2 \div 1.77 \approx \text{antilog}(1.33) = 10^{1.33}$
- From graph $10^{0.33} \approx 2.1$ so $10^{1.33} \approx 21$.
- Check: Is the answer $\boxed{21}$ reasonable? Yes, about $40 \div 2 = 20$.

Examples:

Example: Find 352/17.7 using logs and tables.

Hint: $\log(3.52) \approx 0.5465$ and $\log(1.77) \approx 0.2480$

A= done B= I'm working! C= confused

My Steps:

(1) $\log(352) = 2 + \log(3.52) \approx 2.5465$ (move the decimal point)

(2) $\log(17.7) = 1 + \log(1.77) \approx 1.2480$ (move the decimal point)

(3) Subtract:
$\log(352 \div 17.7) = \log(352) - \log(17.7) \approx 2.5465 - 1.2480 = 1.2985$

(4) So:
$352 \div 17.7 \approx \text{antilog}(1.2985) = 10^{1.2985} = 10^1 \times 10^{0.2985} \approx 19.9$

(5) Check: Is this reasonable? Should be about $350 \div 20 \approx 20$

Did you get close?

A = Yes B = No C = Didn't finish

Powers Using Logs

Or, exploting Log Rule (4):

$$\boxed{\log(a^{p}) = p\log(a)}$$

Use this and the graph of $y = 10^x$ to find $\sqrt{70}$.

One Approach:

(i) Use graph and move decimal point trick to find $\log(70)$

(ii) $\log(\sqrt{70}) = \log(70^{1/2}) = (1/2)\log(70)$

(iii) Take the antilog of result from (ii)

(iv) Think: Is the answer reasonable or did I goof up?

Hint: $\log(7) \approx 0.84$

A= done B= working C= confused

Answer: $\sqrt{70} \approx 8.3$. Is that reasonable?

Computer Applications

One kilobyte (1 KB) is 2^{10}.

Problem: Calculate 2^{10} using logs. **Hint:** $\log(2) \approx 0.3$

A$\approx$ 3 B$\approx$ 10.3 C$\approx$ 30 D$\approx$ 1000 E$\approx$ 1100 $\boxed{\text{D}}$

So: $2^{10} \approx 10^3 = 1000$ (really $2^{10} = 1024$).

1KB is really $2^{10} = 1024 \approx 10^3$ (K is Kilo = thousand)

1MB is really $2^{20} = \left(2^{10}\right)^2 \approx (10^3)^2 = 10^6$ (M is Mega = million)

1GB is really $2^{30} = \left(2^{10}\right)^3 \approx (10^3)^3 = 10^9$ (G is Giga = billion)

1TB is really $2^{40} = \left(2^{10}\right)^4 \approx (10^3)^4 = 10^{12}$ (T is Tera = trillion)

Example: suppose on a certain island the population of rabbits doubles every generation. After 20 generations it multiplies by...
$2^{20} \approx 1$ million.

Powers of 2 are easy to do, even in your head. To work out 2^n the log of the answer is approximately $0.3n$, so 2^n is 1 followed by $0.3n$ zeroes.

Summary of calculations with logs

[Courtesy of Daryl Cooper]

Calculate the log of the thing you want then take antilog of the result.
Example: To calculate $puppy = 17^{3.1}$
(i) doggy $=$ log($puppy$)
(ii) rules of logs to expand doggy
(iii) look up logs of individual terms in doggy. Move decimal point trick.
(iv) Now have numerical value for doggy.
(v) so $puppy =$ antilog($doggy$) is the answer.

Make sure you never jot down a number on its own. It should always be part of an equation like $\log(945 \times 32) \approx 4.48$ This way one can read and understand what is written. Otherwise you get gibberish

Write math the way I do. With words and equations. One should be able to read and understand what is on the paper without being telepathic.
Imagine it is a report for your employer. In reality you are explaining it to yourself.