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Inverses!

logs are "opposite" of exponents (inverse function of antilog)
So every fact about exponents corresponds to a fact about logs:

	laws of exponents	corresponding law of logs
(1)	$10^a \times 10^b = 10^{a+b}$	$\log(xy) = \log(x) + \log(y)$
(2)	$10^0 = 1$	$\log(1) = 0$
(3)	$10^{-a} = 1/10^a$	$\log(1/x) = -\log(x)$
(4)	$(10^a)^p = 10^{ap}$	$\log(x^p) = p\log(x)$
(5)	$10^a/10^b = 10^{a-b}$	$\log(x/y) = \log(x) - \log(y)$

Example: $\log(x^a/y^b) = ?$

(A) $a\log(x)/(b\log(y))$

(B) $a\log(x) + b\log(y)$

(C) $a\log(x) - b\log(y)$

(D) $(a + \log(x)) - (b + \log(y))$

Answer: $\boxed{\text{C}}$

Rule (4): $\log(x^p) = p\log(x)$

Explanation of (4)

$\log(a \times a) = \log(a) + \log(a) = 2\log(a)$
$\log(a \times a \times a) = \log(a) + \log(a) + \log(a) = 3\log(a)$

In general: the number of tens you multiply to get x^p is p times as many tens as you multiply to get x.

What is $\log(\sqrt{x^7})$?

(A) $7 + \log(x)$ (B) $(7/2) + \log(x)$ (C) $7/2$ (D) $7/2\log(x)$ $\boxed{\text{D}}$

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)

1. Find $\log(573)$

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

(2) $\log(5.73) \approx 0.7582$

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

2. Find $\log(57.3)$ Answer: $\boxed{C}$

(A) ≈ 7.582 (B) $\approx 10 + 0.7582$ (C) $\approx 1 + 0.7582$ (D) Other

3. Find $\log(0.573)$ Answer: $\boxed{B}$

(A) ≈ -1.7582 (B) $\approx -1 + 0.7582$ (C) ≈ -0.7582 (D) Other

Finding the antilog of any number

4. 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)?

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

This is like the moving decimal point trick for logs.

5. Find antilog(3.86). From the log table we know $10^{0.86} \approx 7.25$.
Answer: $\boxed{\approx 7250}$

(A) I got it right (B) I was close (C) I was wrong

§7.5: Using logs to multiply

First rule of logs:

$$\boxed{\log(a \times b) = \log(a) + \log(b)}$$

6. 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) working (B) talking (C) confused (D) done

§7.5: Using logs to multiply

First rule of logs:

$$\boxed{\log(a \times b) = \log(a) + \log(b)}$$

6. 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

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

$= 0.43 \qquad = 0.20$

$0.43 + 0.20 = 0.63 \longleftarrow$ 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.**

- **Write your work properly.**
- Eat your fruits & vegetables
- Exercise regularly
- Get enough sleep

Another Example:

7. Find 352×17.7 using logs and tables.

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

(A) working (B) talking (C) confused (D) done

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

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

(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

Rule 5 of logs:

$$\boxed{\log(a \div b) = \log(a) - \log(b)}$$

8. Find 38.2/1.77 using logs.
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) working (B) talking (C) confused (D) done

§7.5: Using logs to divide

Rule 5 of logs:

$$\boxed{\log(a \div b) = \log(a) - \log(b)}$$

8. Find 38.2/1.77 using logs.
Hint: $\log(3.82) \approx 0.58$ and $\log(1.77) \approx 0.25$

Look how I write the answer.

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

You Try It:

9. Find 352/17.7 using logs and tables.

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

(A) working (B) talking (C) confused (D) done

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

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

(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