Welcome To Math 34A! Differential Calculus

Instructor:

Trevor Klar, `trevorklar@math.ucsb.edu`
South Hall 6431X (Grad Tower, 6th floor, blue side, first door on the right)

Office Hours:

MTWR after class 2:00-3:00, and by appointment. Details on Gauchospace.

Quiz Corrections

While doing well on the quizzes is important, what is more important to me is that you learn the material so that you can do well on the Midterm Exams and the Final. To that end, you can optionally do **Quiz Corrections** after your quiz is graded. To get credit back on your quizzes, please answer the following in your own **words**:

- What was the problem was asking you to do?
- What was the mistake(s) in your work?
- Correctly and completely rework the problem, explaining your steps as you go.
- We know that mistakes are simply an opportunity to learn; what did you learn from this mistake?

then **for each problem you correct, you will earn 50% of the missing points back on the corresponding Quiz.** This means a 50% can be corrected to a 75%, a 90% to a 95%, etc. Quiz corrections are due 1 week after the graded quiz is posted.

Announcements

- Thursday is the last day to drop a class in Session A.
- I will have the exams graded ASAP (hopefully today or tomorrow morning).

Counting and Our Logarithmic Perception of the World

Vsauce:
1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,
28,29,30,31,32,33,34,35...
`https://www.youtube.com/watch?v=Pxb5lSPLy9c`

Warm-up

- $\log_9(9^4) =$

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Warm-up Part II

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Logs are "opposite" of exponentials (that's why we sometimes call 10^x as 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)	$10^a/10^b = 10^{a-b}$	$\log(x/y) = \log(x) - \log(y)$

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

$A = a\log(x)/(b\log(y))$ $\qquad B = a\log(x) + b\log(y)$

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

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

Explanation of (4)

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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 $\log\left(\sqrt{\frac{1}{x^7}}\right)$?

$A = 7 - \log(x) \quad B = (7/2) - \log(x) \quad C = -7/2 \quad D = -(7/2)\log(x)$

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Find x by solving $3^x = 5$.

A $\log(5)/\log(3)$
B $\log(3)/\log(5)$
C $\log(5)^3$
D $\log(3) - \log(5)$
E $\log(5) - \log(3)$

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D $\log(3) - \log(5)$
E $\log(5) - \log(3)$ $\boxed{\text{A}}$

§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

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?

§7.5: Using logs to multiply

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Look how I write the answer.

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§7.5: Using logs to multiply

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Look how I write the answer.

- $\log(2.7 \times 1.6) = \log(2.7) + \log(1.6)$
- On the table we see that $\log(2.7) \approx 0.43$ and $\log(1.6) \approx 0.20$, so $\log(2.7 \times 1.6) \approx 0.43 + 0.20 = 0.63$

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- On the table we see that $\log(2.7) \approx 0.43$ 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
- $2.7 \times 1.6 \approx \text{antilog}(0.63) = 10^{0.63}$
- $10^{0.63} \approx 4.3$
- Is my answer $\boxed{4.3}$ reasonable? Yes, about $2 \times 2 = 4$.

§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

Method

(i) Look up log(3.82) and log(1.77), find log(38.2)

⋆You can find log(38.2) by adding 1 to log(3.82) because 38.2 is 3.82 times one more power of 10.⋆

(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: Powers Using Logs

Or, exploiting Log Rule (4): $\boxed{\log(a^p) = p\log(a)}$

Use this to find $\sqrt{70}$.

One Approach:

(i) Use table and move decimal point trick to find $\log(70)$
⋆I will show the graph of the exponential function 10^x and talk about the graph method next lecture.⋆

(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?

A= done B= working C= confused

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

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

A= done B= working C= confused

Answer: $\sqrt{70} \approx 8.32$. 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≈ 3 B≈ 10.3 C≈ 30 D≈ 1000 E≈ 1100

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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)

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Example: suppose on a certain island the population of rabbits doubles every generation. After 20 generations it multiplies by. . .

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$2^{20} \approx 1$ million.

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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.

§7.7: Solving Exponential Eq'ns

1. Find x by solving $10^x = 5$.

A$= 5$ B$= 0.5$ C$= \log(5)$ D$= \log(0.5)$
E$= \log(5) - \log(10)$

§7.7: Solving Exponential Eq'ns

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§7.7: Solving Exponential Eq'ns

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A$=5$ B$=0.5$ C$=\log(5)$ D$=\log(0.5)$
E$=\log(5)-\log(10)$ $\boxed{\text{C}}$

Look how I write the answer!

$$\log(10^x) = \log(5) \quad \text{Take logs of both sides}$$

$$x = \log(10^x) = \log(5) \quad \text{Using } \log(a^p) = p\log(a) \text{ and } \log(10) = 1$$

§7.7: Solving Exponential Eq'ns

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A$= 5$ B$= 0.5$ C$= \log(5)$ D$= \log(0.5)$
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$$x = \log(10^x) = \log(5) \quad \text{Using } \log(a^p) = p\log(a) \text{ and } \log(10) = 1$$

Examples:

Use the Fourth Law:

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

Slogan: Logs bring exponents down to ground level.

2. Solve $3^{x} = 7$

A= $\log(7/3)$ B= $\log(7) - \log(3)$ C= $\log(7) + \log(3)$
D= $\log(3)/\log(7)$ E= $\log(7)/\log(3)$

Examples:

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Look how I write the answer:

$$\log(3^x) = \log(7)$$ Take logs of both sides

$$x\log(3) = \log(3^x) = \log(7)$$ Using $\log(a^p) = p\log(a)$

So: $x = \log(7)/\log(3)$

Examples:

Use the Fourth Law:

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

Slogan: Logs bring exponents down to ground level.

3. Solve $7^{x+2} = 30$.

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Use the Fourth Law:

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All are correct!

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4. Solve $7 \times 3^{y} = 2^{4y+3}$

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$\boxed{\text{A}}$

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Conclusion: Money approximately doubles in 10 years!
So in 20 years multiplies by 4, in 30 years by 8,. . .

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