Logarithmic Functions
<u> </u>
Remember: The inverse of a function, written f <sup>-1</sup> , is a function
such that $f^{-1}(f(x)) = x$ and $f(f^{-1}(x)) = x$
Ev. 1. Chave that $f(y) = 2y + 1$ and $g(y) = 1/2(y + 1)$ are inversed
Ex 1: Show that $f(x) = 3x + 1$ and $g(x) = 1/3(x - 1)$ are inverses.

How do you find the inverse of a function?

Ex 2) Find the inverse of 
$$f(x) = \frac{2}{3+x}$$

Silent Board Game:

<u>8</u>	1/2	<u>32   1</u>	16 4	3 6	64 2	0	.25	<u>-1</u>
Ц							- 7	
		ı						
					•			

$$\sqrt{2}$$
 | .2 |  $1/8$ 

Name:		Date:			
Topic:		Class:			
Main Ideas/Questions	Notes/Examples				
What is a	A logarithm (log) is another way of writing exponents.				
LOGARITHM?	Logarithmic Form $\log_b a = x$	Exponential Form			
	Read as "log b	ase $b$ of $a$ equals $x$ ."			
C	<b>Directions:</b> Write each equation in <b>e</b>	xponential form.			
Converting  LOG © EXP	<b>1.</b> log <sub>3</sub> 9 = 2	<b>2.</b> log <sub>6</sub> 216 = 3			
	<b>3.</b> log <sub>7</sub> 1 = 0	<b>4.</b> log <sub>2</sub> 16 = 4			
	<b>5.</b> $\log_4 \frac{1}{16} = -2$	<b>6.</b> $\log_9 27 = \frac{3}{2}$			
•	Directions: Write each equation in Ic	pagrithmic form			
Converting  EXP © LOG	<b>7.</b> 14 <sup>2</sup> = 196	<b>8.</b> 3 <sup>4</sup> = 81			
	<b>9.</b> 12 <sup>1</sup> = 12	<b>10.</b> $36^{\frac{1}{2}} = 6$			
	<b>11.</b> $2^{-3} = \frac{1}{8}$	<b>12.</b> $8^{\frac{4}{3}} = 16$			

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Name:		Date:			
Topic:		Class:			
Main Ideas/Questions	Notes/Examples				
What is a	A logarithm (log) is another way of writing exponents.				
LOGARITHM?	Logarithmic Form	Exponential Form			
	$\log_b a = x$	$b_x = \alpha$			
	Read as "log be	ase b of a equals x."			
Converting	Directions: Write each equation in e	xponential form.  2. log <sub>6</sub> 216 = 3			
LOG © EXP	1. log <sub>3</sub> 9 = 2				
	3 <sup>2</sup> =9	63 = 216			
	3. log <sub>7</sub> 1 = 0	4. log <sub>2</sub> 16 = 4			
	70=1	24 = 16			
	5. $\log_4 \frac{1}{16} = -2$	<b>6.</b> $\log_9 27 = \frac{3}{2}$			
		$q^{3/2} = 27$			
	4-2 = 16	9 - 21			
Convention	Directions: Write each equation in I				
Converting  EXP © LOG	<b>7.</b> 14 <sup>2</sup> = 196	<b>8.</b> 3 <sup>4</sup> = 81			
EXP © LOO	109 14 196=2	log 3 81 =4			
	311				
	<b>9.</b> 12 <sup>1</sup> = 12	<b>10.</b> $36^{\frac{1}{2}} = 6$			
	1091212=1	109 36 6 = 生			
	10312	10030			
	<b>11.</b> $2^{-3} = \frac{1}{8}$	<b>12.</b> $8^{\frac{4}{3}} = 16$			
	•	109 8 16 = #			
	log2 = -3	109814 3			
ti .	•	S			

COMMON LOGARITHM	<b>LOGARITHM</b> logarithm and can be written without the base. $\log_{10} x \longrightarrow$				
EVALUATING	<b>Directions:</b> Use your knowledge of exponents to evaluate the following logarithms.				
LOGARITHMS	<b>13.</b> log <sub>7</sub> 49	<b>14.</b> log <sub>3</sub> 27			
	<b>15.</b> log 100	<b>16.</b> log <sub>12</sub> 1			
	<b>17.</b> log <sub>2</sub> 64	<b>18.</b> log <sub>3</sub> 243			
	<b>19.</b> log <sub>9</sub> $\frac{1}{81}$	<b>20.</b> log <sub>64</sub> 4			
CHANGE OF BASE FORMULA	Some logarithms are not as easy to evalute as those above, and will require the change of base formula. $\log_b a =$				
Choose BASE 10	<b>Directions:</b> Evalute each log using the	change of base formula.			
because there is a calculator button for it!	<b>21.</b> log <sub>16</sub> 64	<b>22.</b> log <sub>8</sub> 32			
	<b>23.</b> log <sub>2</sub> 54	<b>24.</b> log <sub>10</sub> 294			
	<b>25.</b> log <sub>4</sub> 136	<b>26.</b> log <sub>6</sub> $\frac{1}{36}$			
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COMMON LOGARITHM	A logarithm with base 10 is called a <b>common</b> logarithm and can be written without the base. $\log_{10} x \rightarrow \log X$		
EVALUATING LOGARITHMS	Directions: Use your knowledge of explogarithms.  13. log <sub>7</sub> 49	ponents to evaluate the following  14. log <sub>3</sub> 27	
LOGARTINAS	1×=49	3 <sup>X</sup> = 27	
	X=2	X=3	
	<b>15.</b> log 100	<b>16.</b> log <sub>12</sub> 1	
	10 <sup>X</sup> =100 X=2	12 <sup>X</sup> = 1   X = 0	
	17. log <sub>2</sub> 64	18. log <sub>3</sub> 243	
	2×= 64	3 <sup>x</sup> = 243	
	X=6	X=5	
	19. log <sub>9</sub> 1/81	<b>20.</b> log <sub>64</sub> 4	
	$q^{X} = \frac{1}{81}  \boxed{X = -2}$	64 <sup>x</sup> = 4 x= 1/3	
CHANGE OF BASE FORMULA	Some logarithms are not as easy to evalute as those above, and will require the change of base formula. $\log_b a = \frac{\log_b a}{\log_b a}$		
Choose BASE 10	Directions: Evalute each log using the		
because there is a calculator button For iti	109 64 109 16 = [1.5]	$\frac{\log 32}{\log 8} = \boxed{1.7}$	
	23. log <sub>2</sub> 54	<b>24.</b> log <sub>10</sub> 294	
	10g 54 = 5.7549	109 10 = [2.4683]	
	$\frac{\log_4 136}{\log_4 1} = 3.5437$	26. $\log_6 \frac{1}{36}$ $\log_6 \frac{1}{36}$ $= -2$	
l		1096	

Name:				Date:	
Topic:			Class:		
Main Ideas/Questions Notes/Examples					
Product Property $\log_b(m \cdot n) =$	<b>1.</b> log <sub>2</sub> 7 + log <sub>2</sub> 4	garithm. Simplify if possible  2. log 25 + log 4			3. log <sub>4</sub> 2x + log <sub>4</sub> 4x <sup>2</sup>
	Expand using the product		_		C los (F.)
	<b>4.</b> log 6	<b>5.</b> log <sub>7</sub> 45			<b>6.</b> log <sub>2</sub> (5x)
Ountiont	Condense into a single logarithm. Simplify if possible.				
Quotient Property $\log_b\left(\frac{m}{n}\right) =$	<b>7.</b> log <sub>3</sub> 24 – log <sub>3</sub> 8	<b>8.</b> log <sub>2</sub> 15 – log <sub>2</sub> 15		log <sub>2</sub> 15	<b>9.</b> $\log_4 x^9 - \log_4 x^2$
	Expand using the quotient property.				
	<b>10.</b> log <sub>8</sub> 4	<b>11.</b> $\log_5 \frac{1}{3}$			<b>12.</b> $\log\left(\frac{m}{7}\right)$
122	Condense into a single lo	garithm. Sir	m	plify if possible	).
Power Property $\log_b m'' =$	<b>13.</b> 5·log <sub>4</sub> 2	<b>14.</b> 7 · log <sub>2</sub>	2 ,	r	<b>15.</b> $\frac{1}{3}$ · log 8
	Expand using the power p	roperty. Sin	n	plify if possible	
	<b>16.</b> log <sub>2</sub> 8 <sup>7</sup>	<b>17.</b> 3·log	4	x – 1	<b>18.</b> $\log_7 \sqrt{w}$

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Name:			Da	te:		
Topic:			Cla	iss:		
Main Ideas/Questions	Notes/Examples			**		
Droducet	Condense into a single logarithm. Simplify if possible.					
Product	1. log <sub>2</sub> 7 + log <sub>2</sub> 4	2. log 25+log 4			3. $\log_4 2x + \log_4 4x^2$	
Property	10927.4	log 25	5.6	l _	$\log_4 2x \cdot 4x^2$ $\log_4 8x^3$	
$\log_b(m \cdot n) =$	109 2 28	Ing	100		[m., 8x3]	
(logbm+logbn)		1				
	Expand using the product					
	4. log 6	<b>5.</b> log <sub>7</sub> 45			<b>6.</b> $\log_2(5x)$	
Answers ->	log 2.3	109,5.	9		10925·X	
NOW.	log 2+log 3	10915	+	10979	log 2 + log 2X	
	Condense into a single le	andthe Cir		e lif manath la		
Quotient	Condense into a single lo 7. log <sub>3</sub> 24 – log <sub>3</sub> 8	8. log <sub>2</sub> 15 -			9. log <sub>4</sub> x <sup>9</sup> – log <sub>4</sub> x <sup>2</sup>	
Property	log3 24	7729			100/4 ×9	
()	20.8	10921	5		10 J4 X2	
$\log_b\left(\frac{m}{n}\right) =$	log 3	1092			1094 X7	
1096m-1096n	Expand using the quotient property.					
	10. log <sub>8</sub> 4	11. log <sub>5</sub> 1/3			<b>12.</b> $\log\left(\frac{m}{2}\right)$	
Arswers	1098 2	logs #	5		<del></del>	
way!	10988-10982	109515		9545	log m - log 7	
	Condense into a single lo	garlfhm. Sin	nplify	/ if possible	).	
Power	13. 5·log <sub>4</sub> 2	14. 7·log2	x		15. ½·log 8	
Property	109425	[10] 2 X			log 8"3	
$\log_b m'' = 1000 \text{ m/s}$	109 4 32				109 \$ 8	
n· log b m	Expand using the power p	roperty. Sim	plify			
	<b>16.</b> log <sub>2</sub> 8 <sup>7</sup>	17. 3·log 4		,	18. log <sub>7</sub> √w	
	7.109,28	X-1.3.	loa	4	109 7 W1/2	
	1.1120	(3x-		6000	12. log 1 W	
					Gina Wilton (All Thiorr Alrebra) 2015	

Name:		Unit 7: Exponenti	al & Logarithmic Functions	
Date:	Bell:	Homework 3: Int	tro to Logarithms	
Directions: Write each equation	in exponential	form.		
<b>1.</b> log <sub>2</sub> 128 = 7	<b>2.</b> log <sub>8</sub> 64 = 2		<b>3.</b> $\log_3 \frac{1}{27} = -3$	
<b>Directions:</b> Write each equation	in logarithmic	form.		$\dashv$
<b>4.</b> 4 <sup>4</sup> = 256	<b>5.</b> $8^3 = 512$		<b>6.</b> $27^{\frac{2}{3}} = 9$	
<b>Directions:</b> Evaluate each logar		hange of base form		_
<b>7.</b> log <sub>6</sub> 36	<b>8.</b> log <sub>2</sub> 32		<b>9.</b> log <sub>4</sub> 64	
<b>10.</b> log <sub>3</sub> 81	<b>11.</b> log <sub>100</sub> 10		<b>12.</b> $\log_7 \frac{1}{7}$	
<b>13.</b> log <sub>18</sub> 1	<b>14.</b> log <sub>2</sub> $\frac{1}{16}$		<b>15.</b> log 1000	
<b>16.</b> log <sub>16</sub> 8	<b>17.</b> log <sub>243</sub> 27		<b>18.</b> log <sub>3</sub> 92	
<b>19.</b> log <sub>7</sub> 35	<b>20.</b> log <sub>2</sub> 260		21. log <sub>5</sub> 38	

Name:	_	Unit 7: Exponential & Logarithmic Functions	
Date:	_ Bell:	Homework 3: Intro to Logarithms	

Date:	Bell: Homework 3: In	itro to Logarithms
Directions: Write each equation	in exponential form.	
<b>1.</b> log <sub>2</sub> 128 = 7	2. log <sub>8</sub> 64 = 2	3. $\log_3 \frac{1}{27} = -3$
27= 128	8 <sup>2</sup> = 64	
	8 .	3-3 = 1
Directions: Write each equation	in logarithmic form.	
<b>4.</b> $4^4 = 256$	<b>5.</b> $8^3 = 512$	6. 27 3 = 9
1094256=4	log8512=3	10927 9= =================================
<b>J</b> .	J.	10927 1 3
Directions: Evaluate each logar	ithm. Use the change of base form	nula when necessary.
<b>7.</b> log <sub>6</sub> 36	8. log <sub>2</sub> 32	9. log <sub>4</sub> 64
6 <sup>x</sup> = 36	2 <sup>x</sup> =32	4× = 64
X=2	X=5	X=3
		القسقال
<b>10.</b> log_3 81	<b>11.</b> log <sub>100</sub> 10	<b>12.</b> $\log_7 \frac{1}{7}$
3 <sup>x</sup> = 81	100×=10	7×=+
x=4	X=1/2	[X=-]
12 land	•	
<b>13.</b> log <sub>18</sub> 1	<b>14.</b> $\log_2 \frac{1}{16}$	15. log 1000
18× = 1	2×=16	10X = 1000
X=0	<u> </u>	X=3
	X=-4	12   22
<b>16.</b> log <sub>16</sub> 8	<b>17.</b> log <sub>243</sub> 27	<b>18.</b> log <sub>3</sub> 92
$\frac{\log 8}{\log 16} = 0.15$	109 27 -10.6	$\frac{\log a2}{\log 3} = 4.1159$
log 16	10g 27 10g 243 =0.6	1093
<b>19.</b> log <sub>7</sub> 35	<b>20.</b> log <sub>2</sub> 260	<b>21.</b> log <sub>5</sub> 38
10g 35 = [1.8271]	$\frac{100260}{1092} = 8.0024$	$\frac{\log 38}{\log 5} = 2.2602$
1097	109 2	109 5
- 0	•	<b>'</b>

	Putting it All Together!					
	<b>Directions:</b> Rewrite as a single logarithm. Simple	lify if possible.				
	<b>19.</b> 2·log 6 – log 9	<b>20.</b> $4 \cdot \log_4 a + 2 \cdot \log_4 b$				
NG LOGS	<b>21.</b> $7 \cdot \log_4 u - 3 \cdot \log_4 v^2$	<b>22.</b> log <sub>2</sub> 15 + log <sub>2</sub> 4 – log <sub>2</sub> 6				
CONDENSING LOGS	<b>23.</b> $\log_3 4 + \log_3 y + \frac{1}{2} \cdot \log_3 49$	<b>24.</b> $\frac{1}{3} (\log_5 8 + \log_5 27) - \log_5 3$				
3	<b>25.</b> 3·log <sub>2</sub> 4 – log <sub>2</sub> 32	<b>26.</b> $2 \cdot \log 6 - \frac{1}{4} \cdot \log 16 + \log 3$				
	<b>Directions:</b> Expand each logarithm.					
roes	$27. \log_6 \left( xyz^4 \right)$	$28. \log_4\left(\frac{a^9}{b}\right)$				
EXPANDING	<b>29.</b> $\log_7 (q^4 r^2)^2$	<b>30.</b> $\log_2\left(\frac{y}{z^5}\right)^2$				
EXP/	<b>31.</b> $\log \sqrt{7x^3}$	<b>32.</b> $\log_3 \sqrt[4]{m^5 n^2}$				
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Durthing it All Todath and			
-	Putting it All Together!		
	<b>Directions:</b> Rewrite as a single logarithm. Simp <b>19.</b> 2 log 6 – log 9	lify if possible. <b>20.</b> $4 \cdot \log_4 a + 2 \cdot \log_4 b$	
	A CARREST AND A	1094 a4 + 1094 b2	
	109 62 = 109 36 = 109 4		
İ		1094 a 462	
SS			
Ŏ	21. 7·log <sub>4</sub> u – 3·log <sub>4</sub> v <sup>2</sup>	22. log <sub>2</sub> 15+log <sub>2</sub> 4 - log <sub>2</sub> 6	
<u> </u>	1094 47 - 1094 V	109215.4	
Ž	1094 W		
CONDENSING LOGS	1094 70	109210	
Z	<b>23.</b> $\log_3 4 + \log_3 y + \frac{1}{2} \cdot \log_3 49$	<b>24.</b> $\frac{1}{3} (\log_5 8 + \log_5 27) - \log_5 3$	
	log 3 4 · 4 · 49 1/2	logs 8 13. 273 . logs 2.3	
Ž	10934.4.7 = 1093284	, ,	
ဗ	1095 1 1 1	= 100/52	
	25. 3·log <sub>2</sub> 4 – log <sub>2</sub> 32	<b>26.</b> $2 \cdot \log 6 - \frac{1}{4} \cdot \log 16 + \log 3$	
	109243 - 1092 64		
	32	$\log \frac{b^2}{1b^{14} \cdot 3} = \log \frac{36}{b} = \log 6$	
	= log 22	16 3	
	Directions: Expand each logarithm.		
9	<b>27.</b> $\log_6(xyz^4)$	<b>28.</b> $\log_4\left(\frac{a^9}{b}\right)$	
S	logu X + logu y + logu z+	109 4 a 4 - 109 4b	
ŏ	log . X + log . y + 4 log . 2	9. log 4 a - log 4 b/	
de Logs			
	<b>29.</b> $\log_7 \left(q^4 r^2\right)^2$	30. $\log_2\left(\frac{y}{z^5}\right)^2 = 2\left(\log_2 y - \log_2 z^{5}\right)$	
Ă	$2(\log_{7}q^{4} + \log_{7}r^{2})$	=2(logzy-5logzt)	
Ż	2 (4.109-9+210g-r)=8109-9+410		
A C			
EXPANDIN	31. $\log \sqrt{7x^3} = \frac{1}{2} (\log 1 + \log X^3)$	32. $\log_3 \sqrt[4]{m^5 n^2} = \frac{1}{4} (\log_3 m^5 + \log_3 n^2)$	
ш	$= \frac{1}{2} (\log 7 + 3 \log x)$	=4(5log3m + 2log3n)	
	= 1 log 7 + 3 log x	$=\frac{5}{4} \log_3 m + \frac{1}{2} \log_3 n$	
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## PROPERTIES OF LOGARITHMS

Name	Rule(s)	Exam
BASIC LOGARITHMS	$\log_b b = 1$ ; $\log_b 1 = 1$	<b>Simp</b> log <sub>14</sub> 14 =
PRODUCT	$\log_b(m \cdot n) =$	Condi log <sub>5</sub> 6 +
QUOTIENT RULE	$\log_b\left(\frac{m}{n}\right) =$	Condi log <sub>4</sub> 84 –
POWER	$\log_b m^n =$	Condi 2 · log
CHANGE OF BASE FORMULA	$\log_b a =$	<b>Usin</b> log <sub>7</sub> 32 =
REMEMBER: E	REMEMBER: BASE 10 LOGS ARE COMMON LOGS AND WRITTEN	WRITTEN

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GRAPHIC ORGANIZER

Name	Rule(s)	Example 1	Example 2
BASIC	$\log_b b = 1  ;  \log_b 1 = 0$	Simplify:	Simplify:
SALLI TAURON		10914 14 = 1	log <sub>3</sub> 1= <i>C</i>
1		Condense:	Expand:
PRODUCT	$\log_b(m \cdot n) = \log_b m + \log_b n$	log <sub>5</sub> 6 + log <sub>5</sub> 7 =	log <sub>2</sub> 63 =
		109 5 42	10927 + 10929
į		Condense:	Expand:
RULE	$\log_b\left(\frac{m}{n}\right) = \log_b m - \log_b n$	109, 84 - 109, 12 = 109 4 7	6 601 - 18 601 = 6 601
i i		Condense:	Expand:
RULE	$\log_b m^n = \Omega \cdot \log_b M$	2.109,8 = [D3,364]	$ \log_2 6^{x-1} $
		2	
CHANGE	loga	Using a common base, evaluate the expression below.	base, evaluate ion below.
OF BASE	log, a = 109 b	109, 32 = 109 32	= 1.7810
FURINDLA		<u>8</u>	
REMEMBER: E	REMEMBER: BASE 10 LOGS ARE COMMON LOGS AND WRITTEN WITHOUT A BASE! (log x)	WRITTEN WITHOUT A	BASE! (log x)

Name:	Un	it 7: Exponential	& Logarithmic Functions
Date:	Bell: Homework 4: Pr		perties of Logarithms
*	* This is a 2-page	document! **	]
Directions: Complete each rule			
PRODUCT RULE	QUOTIENT	T RULE	POWER RULE
$\log_b\left(m\cdot n\right) =$	log,	$\left(\frac{m}{n}\right) =$	$\log_b m^n =$
logb m+ logb n	1096 m - 100	36h	N·log <sub>b</sub> m
Directions: Condense each exp	ression into a single	logarithm. Simp	olify if possible.
1. log, 9+ log, 4 log, 9.4 = log		log <sub>2</sub> 80 - log <sub>2</sub> 5	= log 2 16
3. ½·log <sub>3</sub> 81	4	3 · log <sub>4</sub> 8 – 5 · log	42
$ 09_38 ^{1/2} =  09_3\sqrt{8} $ $=  09_3\sqrt{8} $			= log 4 512 = log 4 16
5. $7 \cdot \log_5 x + 3 \cdot \log_5 y^4$ $\log_5 x^7 \cdot y^{12}$ $= \left[\log_5 x^7 y^{12}\right]$	6	1093 a <sup>7</sup> + (1093 a <sup>2</sup> + 1093	$\frac{1-2 \cdot \log_3 b}{a^2} = \frac{\log_3 a}{b^2}$
7. $\log_4 x^7 - \log_4 x^2 + 4 \cdot \log_4 x^3$ $\log_4 \frac{\chi^7}{\chi^2} \cdot \chi^{12} =$	1094 X19	$\frac{1}{2}(\log_6 45 - \log_6 45 - \log_6 \frac{1}{5})^{1/2}$	
-[	094 X17	= 10g , 91/2 = 10g , 3.	12 = \[ \log 6 36 \]  Gra Wilson [All Thing: Algebra], 2015

Directions: Condense, then use the change of	base formula to evaluate the logarithm.
9. log <sub>9</sub> 35 – log <sub>9</sub> 7	10. 2 · log <sub>3</sub> 8 - 4 · log <sub>3</sub> 2
10g q 35	109382
$\log_{9}5 \rightarrow \frac{\log_{5}}{\log_{9}} = 0.7325$	$\log_3 \frac{64}{16}$ $\log_3 \frac{1004}{1003} = 1.2619$
	10934
11. $\frac{1}{3} \cdot \log_4 8 + \log_4 15$	12. $\log_2 27 + \log_2 4 - 2 \cdot \log_2 3$
log 48"3.15	1092 27.4
1094 2.15 1094 30 1094 = 2.4534	$\log_2 \frac{108}{9}$ $\frac{\log_1 2}{\log_2 2} = 3.5850$
	109212

Directions: Expand each expression.	
$13. \log_{8}(mn^{2})$ $[\log_{8} M + 2\log_{8} N]$	14. $\log \left( \frac{x^9}{y^4} \right)$ $[9 09 X-4 09 y]$
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	16. $\log \left(\frac{p^4}{q^7}\right)^2$ $\log \frac{p^8}{q^{14}}$ $8\log p - 14\log q$
$\frac{17. \log_5 \sqrt{a^7 b}}{\log_5 0} \sqrt{\frac{1}{2}  b ^2 2}$ $\frac{1}{2} \log_5 0 + \frac{1}{2} \log_5 b$	18. logy \$\frac{3\c^2 a^{15}}{2^{13}} \log_4 C^{2/3} d^5 \[ \frac{2}{3} \log_4 C + 5 \log_4 d \right]

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