$\frac{n^5}{n^2}$ $x^3 \cdot x^2 =$

Algebra 2 7.5

Simplify and evaluate expressions using the properties of logarithms

Solve logarithmic equations

logarithm = exponent

product rule add expon.

quotient rule subtract expon.

power^power mult expon.

$\star \left(x^3\right)^4$

log=exponent so same rules apply

$x^2 x^3$

KeyConcept Product Property of Logarithms

Words	The logarithm of a product is the sum of the logarithms of its factors.
Symbols	For all positive numbers a, b, and x, where $x \neq 1$, $\log_x ab = \log_x a + \log_x b$.
Example	$\log_2 (5)(6) = \log_2 5 + \log_2 6$

$x^2 \cdot x^3 = x^5$

Example 3 Power Property of Logarithms

Given $\log_2 5 \approx 2.3219$, approximate the value of $\log_2 25$.

Write as combination of 2s & 5s
Check answer

BOGO: $\log_2 2$ $\log_2 2 = 1$

$2^{2.3219} = 5$

$2^1 = 2$

$2^? = 25$

$\log_2(5 \cdot 5) = \log_2 5 + \log_2 5$

$2.3219 + 2.3219$

$= 4.6438$

$2^{4.6438} = 25$

$3 \cdot 64$

$3 \cdot 8 \cdot 8$

$3 \cdot 4 \cdot 4 \cdot 4$

BOGO: $\log_4 4 =$

27
81
12

Example 1 Use the Product Property

Use $\log_4 3 \approx 0.7925$ to approximate the value of $\log_4 192$.

How can I write 192?
write using factors of :
3 (given) and 4 (base)
combine by adding exponents
check answer

$\log_4 4 = 1$

$\log_4 192 = \log_4 (3 \cdot 4 \cdot 4 \cdot 4) = \log_4 3 + \log_4 4 + \log_4 4 + \log_4 4$

$\approx 0.7925 + 1 + 1 + 1$

≈ 3.7925

3.7925
4

GuidedPractice

1. Use $\log_4 2 = 0.5$ to approximate the value of $\log_4 32$.

$\log_4 4 = 1$

BOGO: $\log_4 4$

write using factors of 2 and 4

(base)

$\log_4(2 \cdot 4 \cdot 4) = \log_4 2 + \log_4 4 + \log_4 4$

$= 0.5 + 1 + 1$

$= 2.5$

2.5

$4 =$

GuidedPractice

3. Given $\log_3 7 \approx 1.7712$, approximate the value of $\log_3 49$.

BOGO: $\log_3 3$

Write as combination of 3s & 7s (base)

$$\log_3(7 \cdot 7) = \log_3 7 + \log_3 7$$

$$= 1.7712 + 1.7712$$

$$=$$

Log=exp so follow same rules x^5/x^2

$$\frac{x^5}{x^2}$$

KeyConcept Quotient Property of Logarithms

Words	The logarithm of a quotient is the difference of the logarithms of the numerator and the denominator.
Symbols	For all positive numbers a, b, and x, where $x \neq 1$, $\log_x \frac{a}{b} = \log_x a - \log_x b$.
Example	$\log_2 \frac{5}{6} = \log_2 5 - \log_2 6$

Hint: divide out -1 to solve for log
Write in exp form

Real-World Example 2 Quotient Property

SCIENCE The pH of a substance is defined as the concentration of hydrogen ions $[H^+]$ in moles. It is given by the formula $pH=-\log_{10}H^+$. Find the amount of hydrogen in a liter of acid rain that has a pH of 4.2.

$$pH=-\log_{10}H^+$$

Note change in formula

Write in exp form

log=exp so follow same rules: $(x^2)^4$

KeyConcept Power Property of Logarithms

Words	The logarithm of a power is the product of the logarithm and the exponent.
Symbols	For any real number p, and positive numbers m and b, where $b \neq 1$, $\log_b m^p = p \log_b m$.
Example	$\log_2 6^5 = 5 \log_2 6$

hint: exponents mean repeated multiplication

$\log_5 3 = 0.6826$ $\log_5 4 = 0.8614$ $\log_5 2 = 0.4307$

$\log_5 30$ $\log_5 5 = 1$

30 $\log_5 (5 \cdot 3 \cdot 2) = \log_5 5 + \log_5 3 + \log_5 2$

$5 \cdot 3 \cdot 2$ $= 1 + 0.6826 + 0.4307$

$5^{2.1133}$ $= 2.1133$

What does it mean if exponents are added?

X

bae $x = 12$

1. mult
2. exp form
3. solve
4. check ans

Example 4 Solve Equations Using Properties of Logarithms

Solve $\log_6 x + \log_6 (x - 9) = 2$.

$\log_6 x(x-9) = 2$

$\log_6 (x^2 - 9x) = 2$

$6^2 = x^2 - 9x$

$36 = x^2 - 9x$

$0 = x^2 - 9x - 36$

$0 = (x-12)(x+3)$

-36
-12 +3
-9

$x = 12$
$x = -3$

$\log_4 4 + \log_4 9 = 2$

4B. $\log_6 x + \log_6 (x + 5) = 2$

$\log_6(x(x+5)) = 2$

$\log_6(x^2+5x) = 2$

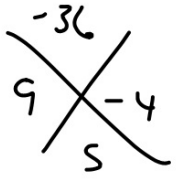
$36 = x^2+5x$

$0 = x^2+5x-36$

$0 = (x+9)(x-4)$

~~$x = -9$~~

$x = 4$



What does it mean if exponents are multiplied?

GuidedPractice

4A. $\log_7 x^2 = \log_7 27 + \log_7 3$

$(x^3)^2 = x^6$

$x^2 = (27 \cdot 3)$

$x^2 = 81$

$x = \pm 9$

$x = 9$

$\frac{x^5}{x^3}$

$(x^2)^3$

$x^2 \cdot x^3$

$\log_7 100 - \log_7 (y+5) = \log_7 10$

$\log_7 \left(\frac{100}{y+5}\right) = \log_7 10$

$\frac{100}{(y+5)} = \frac{10}{1}$ $\quad y = 5$

$10y + 50 = 100$

$10y = 50$