Unit 2 (1.3) **Exponents and Logarithms Notes**

Warm-Up:

1. $64 = 8^{x-6}$

2. $100^x = 100{,}000$

3. $9^{-x+3} = 27^{x-3}$

4. $16^{2x} = 9^{3x-5}$

Evaluate each expression. The first two have been completed for you.

a. $\text{WhatPower}_2(8) = 3$	b. $\text{WhatPower}_3(9) = 2$
c. $\text{WhatPower}_6(36) =$ ______	d. $\text{WhatPower}_2(32) =$ ______
e. $\text{WhatPower}_{10}(1000) =$ ______	f. $\text{WhatPower}_{10}(1{,}000{,}000) =$ ______
g. $\text{WhatPower}_{100}(1{,}000{,}000) =$ ______	h. $\text{WhatPower}_4(64) =$ ______
i. $\text{WhatPower}_2(64) =$ ______	j. $\text{WhatPower}_9(3) =$ ______
k. $\text{WhatPower}_5(\sqrt{5}) =$ ______	l. $\text{WhatPower}_{\frac{1}{2}}\left(\frac{1}{8}\right) =$ ______
m. $\text{WhatPower}_{42}(1) =$ ______	

•Logarithms help get the variable out of the exponent. Logs are inverses of exponents.

$\boldsymbol{y = b^x}$ $(exponential\ form)$ **is equivalent to:** $\boldsymbol{log_b(y) = x}$ $(logarithmic\ form)$

Example: $\boldsymbol{2^3 = 8}$ **is equivalent to** $\boldsymbol{log_2 8 = 3}$

Convert the following into exponential form:

1. $log_5 15625 = 6$

2. $log_{\frac{1}{2}}\left(\frac{1}{16}\right) = 4$

3. $log_3 27 = 3$

Convert the following into logarithmic form:

4. $7^3 = 343$

5. $\frac{1}{2}^{-5} = 32$

6. $4^{-3} = \frac{1}{64}$

What is the purpose of being able to change from one form to the other?

$log_3 x = -5$

$10^x = 100{,}000$

Practice:

Put the following in exponential form and solve.

1. $log_2 64 = x$

2. $log_3 81 = x$

3. $log_4\left(\frac{1}{16}\right) = x$

4. $log_5 x = -2$

5. $log_{49} x = \frac{1}{2}$

6. $log_{16} 64 = x$

7. $log_4(5x + 1) = 2$

8. $log_6(9x) = 3$

9. $log_2(2x - 4) = 3$

Evaluate.

- $\log_9(729) =$ ______
- $\log_3\left(\frac{1}{243}\right) =$ ______
- $\log_4(4096) =$ ______
- $\log_2(-16) =$ ______
- $\log_{121}(11) =$ ______
- $\log_{512}(8) =$ ______
- $\log_{37}(1) =$ ______
- $\log_{-5}(-78125) =$ ______

Warm-up:

Solve for x.

1. $log_4(2x - 4) = 3$

2. $4^{x+5} = 16^x$

<table>
<tr><td colspan="2" align="center">Properties of Logarithms: *These properties only work if the bases are the same.*</td></tr>
<tr><td align="center"><u>Property of Equality</u>

$\boldsymbol{log_b x = log_b y}$

(if $b > 0,\ b \neq 1$ then $x = y$)

Example: $log_7 x = log_7 3$
$x = 3$</td><td align="center"><u>Product Property</u>

$\boldsymbol{log_b mn = log_b m + log_b n}$

(if m, n, b are positive, $b \neq 1$)

Example: $log_7 12 + log_7 3 = log_7(12 \cdot 3)$
$log_7 36$</td></tr>
<tr><td align="center"><u>Quotient Property</u>

$\boldsymbol{log_b \left(\frac{m}{n}\right) = log_b m - log_b n}$

(if m, n, b are positive, $b \neq 1$)

Example: $log_7 12 - log_7 3 = log_7(\frac{12}{3})$
$log_7 4$</td><td align="center"><u>Power Property</u>

$\boldsymbol{log_b m^p = p log_b m}$

(if m, b are positive, $b \neq 1$ and p is a real number)

Examples: $log_7 2^3 = 3 log_7 2$
$2 log_7 6 = log_7 36$</td></tr>
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Practice:

1. $log_6 4x + log_6 3 = log_6 84$

2. $log_2(x + 2) - log_2(x - 4) = 2$

3. $log_4x + log_48 = 4$

4. $log_{11}6 + 3log_{11}2 = log_{11}3x$

5. $5log_92 = log_94x$

6. $3log_54 - log_52 = log_516x$

7. $log_64x - log_63 = 2$

8. $4log_{14}3 = 2log_{14}x$

9. $log_2 5 + log_2 4x = 7$

10. $log_5 x + log_5 (x+4) = log_5 32$

11. $log_{12} 6x - log_{12}(x+3) = log_{12} 4$

12. $3log_3 3 = log_3(4x - 11)$

13. $6log_4 2 - log_4\left(\frac{1}{2}x + 1\right) = 4log_4 2$

14. $2log_6 12 + log_6 x = 4$