1. Rewrite the following exponential statements as logarithmic statements. \textbf{(EXP→LOG)}

a. $125 = 5^3$
   \[ \Rightarrow 3 = \log_5(125) \]

b. $2^6 = 64$
   \[ 6 = \log_2(64) \]

c. $4^x = 16$
   \[ x = \log_4(16) \]

d. $243 = x^5$
   \[ 5 = \log_x(243) \]

e. $e^x = 9$
   \[ x = \ln(9) \]

f. $x = e^5$
   \[ 5 = \ln(x) \]

2. Rewrite the following logarithmic statements as exponential statements. \textbf{(LOG→EXP)}

a. $3 = \log_2(8)$
   \[ 8 = 2^3 \]

b. $5 = \log_x(243)$
   \[ 243 = x^5 \]

c. $\log_6(x) = 3$
   \[ x = 6^3 \]

d. $\ln(x) = 5$
   \[ x = e^5 \]

e. $\log_4(256) = 2x$
   \[ 2x = \log_4(256) \]

f. $x = \ln(3)$
   \[ x = \log_e(3) \]

\[ 3 = e^x \]
3. Evaluate the following basic logarithm statements.

| a. \( \log_2(32) = 5 \) & b. \( \log_7(49) = 2 \) & c. \( \log_6(6) = 1 \) |
|---|---|---|
| \( 2^5 = 32 \) & \( 7^2 = 49 \) & \( 6^1 = 6 \) |
| \( 2^5 = 32 \) & \( 7^2 = 49 \) & \( 6^1 = 6 \) |

| d. \( \log_4(256) = 4 \) & e. \( \log(1000) = 3 \) & f. \( \ln(e^7) = 7 \) |
|---|---|---|
| \( 4^4 = 256 \) & \( \log_{10}(1000) \) & \( e^7 = e^7 \) |
| \( 10^3 = 1000 \) & \( 10^3 = 1000 \) & \( 10^3 = 1000 \) |

4. Evaluate the following logarithm statements.

| a. \( \log_5(5^{12}) = 12 \) & b. \( (\log_3(3^x))^2 = [\chi]^2 \) & c. \( \log_5(9^3) = 6 \) |
|---|---|---|
| \( 5^{12} = 5^{12} \) & \( \log_3(3^x) \) & \( 3^3 = 9^3 \) |
| \( 5^{12} = 5^{12} \) & \( \log_3(3^x) \) & \( 3^3 = 9^3 \) |
| Written this way \( \log_3(5^{12}) = 12 \) & Written this way \( \log_3(3^x) \) & Written this way \( \log_3(3^x) \) |

| d. \( \log_2(16^5) = 20 \) & e. \( 4^{\log_4(16)} \) & f. \( 3^{\log_3(81)} \) |
|---|---|---|
| \( 2^5 = 16^5 \) & \( \log_4(16) \) & \( \log_3(81) \) |
| \( 2^5 = 16^5 \) & \( \log_4(16) \) & \( \log_3(81) \) |
| Written this way \( \log_3(16^5) = 20 \) & Written this way \( \log_4(16) \) & Written this way \( \log_3(81) \) |

| d. \( 5^{\log_5(12)} = 12 \) & e. \( 4^{\log_3(32)} \) & f. \( e^{\ln(5x)} \) |
|---|---|---|
| Since the bases differ, we could first determine: \( \log_3(32) \) \( \log_5(12) \) \( \log_5(5) \) |
| Since the bases differ, we could first determine: \( \log_3(32) \) \( \log_5(12) \) \( \log_5(5) \) |
| Written this way they are "inverse" operations and are effectively "undo" each other: \( 5^{\log_5(12)} = 12 \) & Written this way they are "inverse" operations and are effectively "undo" each other: \( 5^{\log_5(12)} = 12 \) & Again, these are "inverse" operations and "undo" each other: \( e^{\ln(5x)} = 5x \) |

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**M. Winking  Unit 5-3  page 88**
Evaluate the following using the prime factorization of $9^4$.

$$\log_3(9^4) \quad 3^7 = 9^4$$
$$\log_3\left(\left(3^3\right)^4\right)$$
$$\log_3\left(33 \cdot 33 \cdot 33 \cdot 33\right) =$$
$$\log_3(3^8) = 8$$

Evaluate the following using a recognized property.

$$\log_3(9^4)$$
$$4 \cdot \log_3\left(9\right)$$
$$4 \cdot \log_3\left(3 \cdot 3\right)$$
$$4 \cdot \log_3\left(3\right)$$
$$= 8$$

5. Rewrite each of the following using the property above.

a. $\log_5\left(25\right)$
$$3 \cdot \log_5\left(25\right)$$
$$3 \cdot 2 = 6$$

b. $\log_5\left(14\right)$
$$5 \cdot \log_5\left(14\right)$$

5. ln(9)
$$3 \cdot \ln\left(9\right)$$

6. Evaluate the following with your calculator by changing the base to 3 decimal places

(Show the work to provide reasoning)

$$\log_4\left(9\right) = x$$

$$\log_4\left(9\right) = \frac{\log\left(9\right)}{\log\left(4\right)}$$

THIS IS NOW WRITTEN AS A LOGARITM OF BASE 10

$$\log\left(9\right) \cdot \log\left(2\right)$$

$$X = \log_2\left(9\right)$$

$$X = \frac{\log\left(9\right)}{\log\left(2\right)}$$

$$X = 3.170$$

6. Evaluate the following with your calculator by changing the base to 3 decimal places

a. $\log_5\left(50\right)$
$$\frac{\log\left(50\right)}{\log\left(5\right)} = 2.431$$

b. $\log_6\left(12\right)$
$$\frac{\log\left(12\right)}{\log\left(6\right)} = 1.195$$

- or also -
$$\frac{\ln\left(12\right)}{\ln\left(6\right)} \\ \approx 1.195$$

c. $\log_4\left(4194304\right)$
$$\frac{\log\left(4194304\right)}{\log\left(4\right)} = \frac{11}{43}$$

d. $\log_3\left(212\right)$
$$\frac{\log\left(212\right)}{\log\left(3\right)} = 4.876$$

e. $\log\left(532\right) = 2.726$

f. ln(28) $\approx 3.332$