# Unit 4 Lesson 10: Interpreting and Writing Logarithmic Equations

## 1 Reading Logs (Warm up)

### Student Task Statement

The expression $\log_{10} 1{,}000 = 3$ can be read as: "The log, base 10, of 1,000 is 3."

It can be interpreted as: "The exponent to which we raise a base 10 to get 1,000 is 3."

Take turns with a partner reading each equation out loud. Then, interpret what they mean.

- $\log_{10} 100{,}000{,}000 = 8$
- $\log_{10} 1 = 0$
- $\log_2 16 = 4$
- $\log_5 25 = 2$

# 2 Base 2 Logarithms

## Student Task Statement

| $x$ | $\log_2(x)$ |
|---|---|
| 1 | 0 |
| 2 | 1 |
| 3 | 1.5850 |
| 4 | 2 |
| 5 | 2.3219 |
| 6 | 2.5850 |
| 7 | 2.8074 |
| 8 | 3 |
| 9 | 3.1699 |
| 10 | 3.3219 |

| $x$ | $\log_2(x)$ |
|---|---|
| 11 | 3.4594 |
| 12 | 3.5845 |
| 13 | 3.7004 |
| 14 | 3.8074 |
| 15 | 3.9069 |
| 16 | 4 |
| 17 | 4.0875 |
| 18 | 4.1699 |
| 19 | 4.2479 |
| 20 | 4.3219 |

| $x$ | $\log_2(x)$ |
|---|---|
| 21 | 4.3923 |
| 22 | 4.4594 |
| 23 | 4.5236 |
| 24 | 4.5850 |
| 25 | 4.6439 |
| 26 | 4.7004 |
| 27 | 4.7549 |
| 28 | 4.8074 |
| 29 | 4.8580 |
| 30 | 4.9069 |

| $x$ | $\log_2(x)$ |
|---|---|
| 31 | 4.9542 |
| 32 | 5 |
| 33 | 5.0444 |
| 34 | 5.0875 |
| 35 | 5.1293 |
| 36 | 5.1699 |
| 37 | 5.2095 |
| 38 | 5.2479 |
| 39 | 5.2854 |
| 40 | 5.3219 |

1. Use the table to find the exact or approximate value of each expression. Then, explain to a partner what each expression and its approximated value means.
   a. $\log_2 2$
   b. $\log_2 32$
   c. $\log_2 15$
   d. $\log_2 40$
2. Solve each equation. Write the solution as a logarithmic expression.
   a. $2^y = 5$
   b. $2^y = 70$
   c. $2^y = 999$

# 3 Exponential and Logarithmic Forms

## Student Task Statement

These equations express the same relationship between 2, 16, and 4:

$\log_2 16 = 4$ $\qquad\qquad$ $2^4 = 16$

1. Each row shows two equations that express the same relationship. Complete the table.

| | exponential form | logarithmic form |
|---|---|---|
| a. | $2^1 = 2$ | |
| b. | $10^0 = 1$ | |
| c. | | $\log_3 81 = 4$ |
| d. | | $\log_5 1 = 0$ |
| e. | $10^{-1} = \frac{1}{10}$ | |
| f. | $9^{\frac{1}{2}} = 3$ | |
| g. | | $\log_2 \frac{1}{8} = -3$ |
| h. | $2^y = 15$ | |
| i. | | $\log_5 40 = y$ |
| j. | $b^y = x$ | |

2. Write two equations—one in exponential form and one in logarithmic form—to represent each question. Use "?" for the unknown value.
   a. "To what exponent do we raise the number 4 to get 64?"

   b. "What is the log, base 2, of 128?"

**Activity Synthesis**