

Big Ideas Math®



## Log Race

► **Materials:**

- 6-sided die
- Game board
- 2–4 chips
- Game cards
- Paper
- Pencil

► **Directions:**

Students play in teams of 2–4 players. Players take turns rolling the die and moving their chip the corresponding number of spaces. The space the player lands on designates which type of card the student draws. The student draws the top card from the appropriate pile and follows the directions on the game board. The rest of the team checks the answer. A correct answer earns the player the opportunity to roll the die and move his/her chip next round. An incorrect answer results in a lost turn the next round. The used card is then placed on the bottom of the appropriate pile.

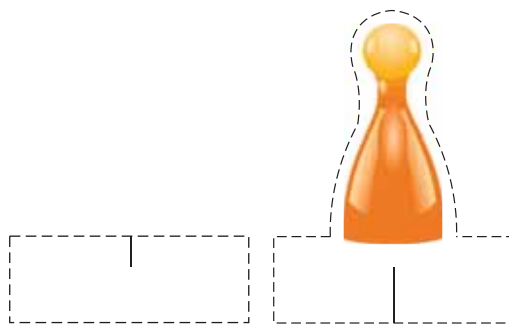
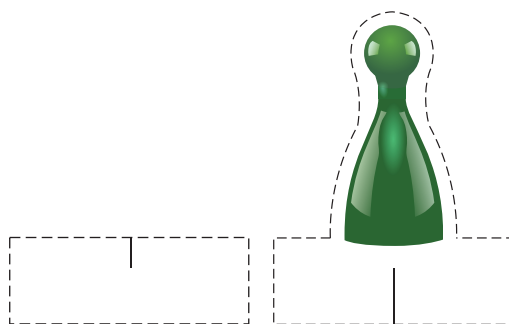
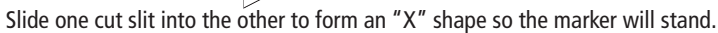
► **Who Wins?**

The player who reaches the FINISH first, or is the closest to the FINISH when time is called, wins.

► **Tip:**

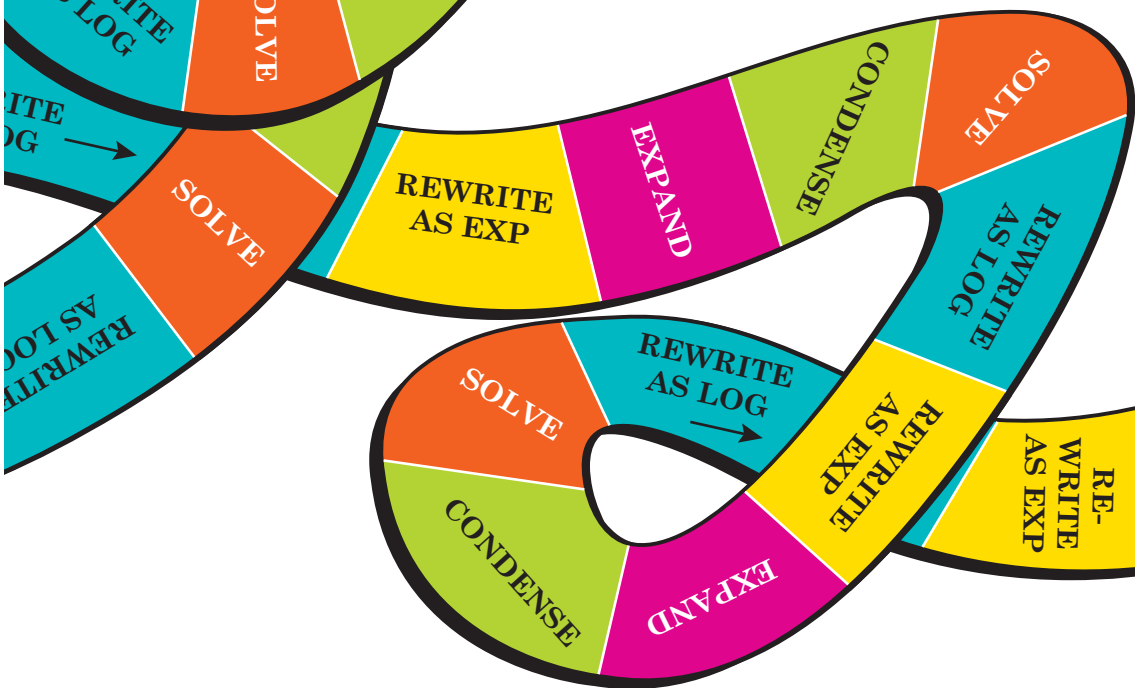
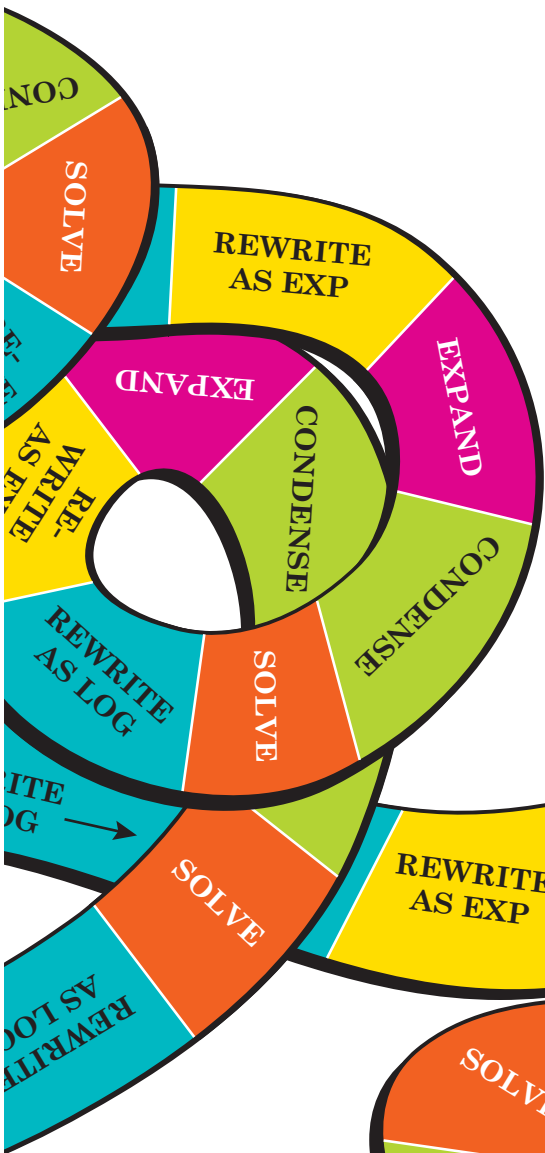
If a color copier or printer is not available, copy each sheet of cards on different colored paper (use game cards for black and white printer).

Game markers are sturdy enough to be made out of copy paper, but for best results, print on card stock and cut out.



Game board size is 11"x 17". Tape game board top and bottom into a manila file folder. That way you can just fold it up with the cards and markers to store for later use. If you do not have 11"x 17" tabloid paper available you can print each side out on 8 1/2"x11" paper and tape the game board in the center.

**\*\*When printing out the game board DO NOT SCALE TO FIT PAGE on the printer settings\*\***



**REWRITE AS LOG**

Place REWRITE AS LOG cards here

Directions: Rewrite the equation in logarithmic form.

**REWRITE AS LOG**

**REWRITE AS EXP**

Place REWRITE AS EXP cards here

Directions: Rewrite the equation in exponential form.

**REWRITE AS EXP**

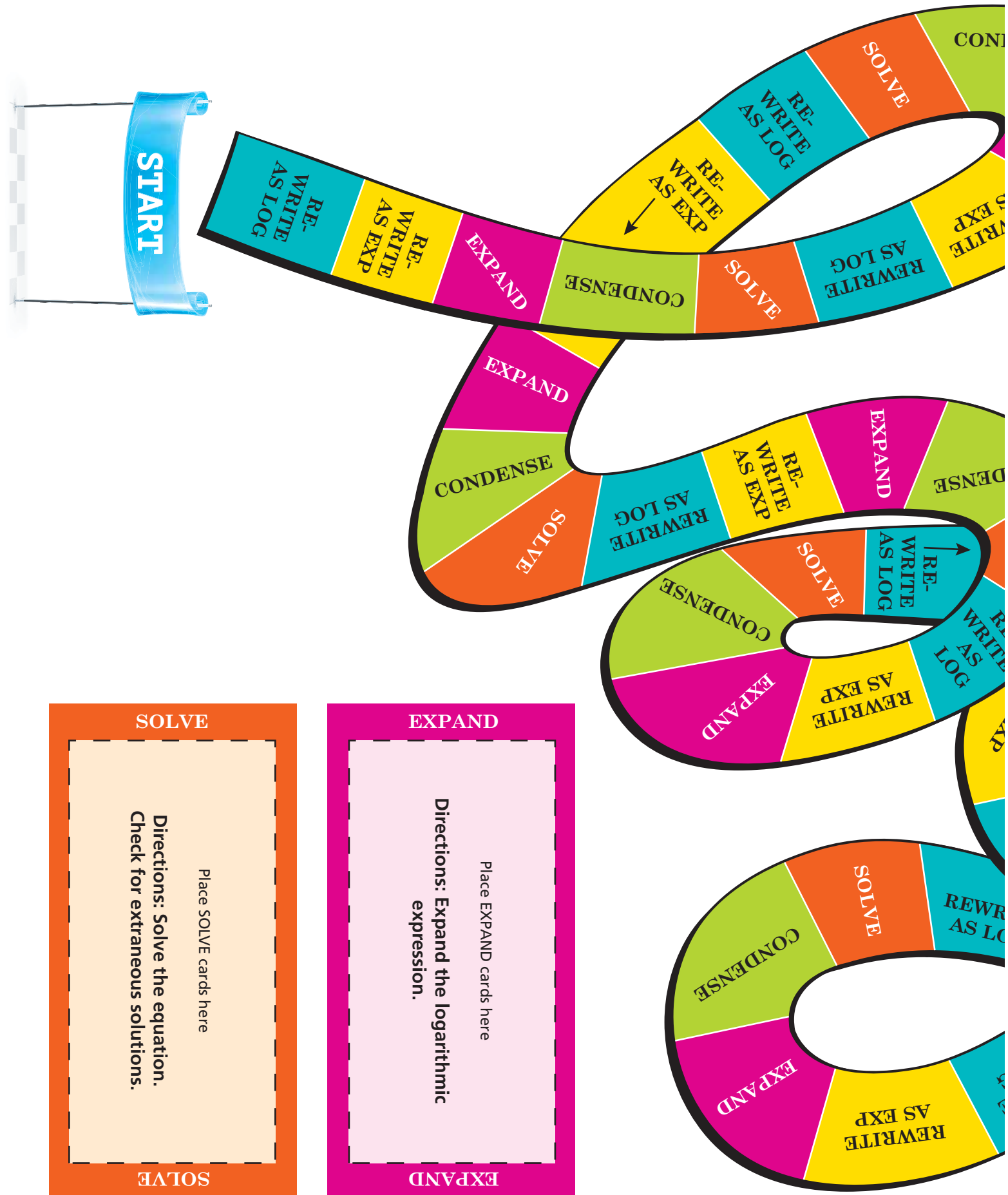
**CONDENSE**

Place CONDENSE cards here

Directions: Condense the logarithmic expression.

**CONDENSE**





REWRITE AS EXP	$\log_3 27 = 3$	REWRITE AS EXP	$\log_9 729 = 3$	REWRITE AS EXP	$\log_4 16 = 2$
REWRITE AS EXP	$\log_{1/9} 81 = -2$	REWRITE AS EXP	$\log_{1/9} \frac{1}{3} = \frac{1}{2}$	REWRITE AS EXP	$\log_{1/9} 3 = -\frac{1}{2}$
REWRITE AS EXP	$\log_2 \frac{1}{4} = -2$	REWRITE AS EXP	$\log_6 1 = 0$	REWRITE AS EXP	$\log 10,000 = 4$
REWRITE AS EXP	$\log \frac{1}{100} = -2$	REWRITE AS EXP	$\log_{12} \frac{1}{144} = -2$	REWRITE AS EXP	$\log_3 81 = 4$
REWRITE AS EXP	$\log_4 64 = 3$	REWRITE AS EXP	$\log_4 4 = 1$	REWRITE AS EXP	$\log_4 2 = \frac{1}{2}$
REWRITE AS EXP	$\log_4 \frac{1}{2} = -\frac{1}{2}$	REWRITE AS EXP	$\log_8 64 = 2$	REWRITE AS EXP	$\log_5 \frac{1}{625} = -4$
REWRITE AS EXP	$\log_{12} \frac{1}{12} = -1$	REWRITE AS EXP	$\log_7 343 = 3$	REWRITE AS EXP	$\log_2 128 = 7$
REWRITE AS EXP	$\log_3 6561 = 8$	<p>“REWRITE AS EXP” Log Race Game Cards — FOR COLOR PRINTER</p>			

REWRITE AS LOG	$6^{-3} = \frac{1}{216}$	REWRITE AS LOG	$7^4 = 2401$	REWRITE AS LOG	$12^2 = 144$
REWRITE AS LOG	$4^{-3} = \frac{1}{64}$	REWRITE AS LOG	$10^3 = 1000$	REWRITE AS LOG	$3^7 = 2187$
REWRITE AS LOG	$7^{-2} = \frac{1}{49}$	REWRITE AS LOG	$\left(\frac{1}{16}\right)^{1/2} = \frac{1}{4}$	REWRITE AS LOG	$\left(\frac{1}{64}\right)^{1/3} = \frac{1}{4}$
REWRITE AS LOG	$\left(\frac{1}{4}\right)^{-1/2} = 2$	REWRITE AS LOG	$\left(\frac{1}{4}\right)^{1/2} = \frac{1}{2}$	REWRITE AS LOG	$\left(\frac{1}{64}\right)^{2/3} = \frac{1}{16}$
REWRITE AS LOG	$\left(\frac{1}{64}\right)^{-2/3} = 16$	REWRITE AS LOG	$11^2 = 121$	REWRITE AS LOG	$3^{-4} = \frac{1}{81}$
REWRITE AS LOG	$4^4 = 256$	REWRITE AS LOG	$4^{-4} = \frac{1}{256}$	REWRITE AS LOG	$256^{1/4} = 4$
REWRITE AS LOG	$256^{-1/4} = \frac{1}{4}$	REWRITE AS LOG	$7^2 = 49$	REWRITE AS LOG	$6^3 = 216$
REWRITE AS LOG	$2^{-3} = \frac{1}{8}$				

“REWRITE AS LOG” Log Race Game Cards —  
FOR COLOR PRINTER

CONDENSE	$9 \log_4 x + 3 \log_4 10 - \frac{1}{3} \log_4 y$	CONDENSE	$2 \ln 11 - 9 \ln y - \frac{1}{2} \ln x$	CONDENSE	$\log 3 + \log 11$
CONDENSE	$\log_3 7 + \log_3 y$	CONDENSE	$\log_5 11 - \log_5 x$	CONDENSE	$\log_3 y - \log_3 4$
CONDENSE	$\log_3 11 + 6 \log_3 x$	CONDENSE	$\frac{1}{2} \log_4 x - 3 \log_4 y$	CONDENSE	$6 \log_4 y + 4 \log_4 x$
CONDENSE	$7 \ln 2 - 3 \ln 4$	CONDENSE	$\ln 11 + 6 \ln x$	CONDENSE	$\ln 8 - 3 \ln x$
CONDENSE	$3 \log 8 + 7 \log x$	CONDENSE	$2 \log_4 9 + 3 \log_4 y - 3 \log_4 x$	CONDENSE	$\log 10 + 4 \log x - \frac{1}{3} \log y$
CONDENSE	$5 \log_3 x - 2 \log_3 12 - 4 \log_3 y$	CONDENSE	$2 \ln 10 + 3 \ln x + 2 \ln y$	CONDENSE	$\frac{1}{2} \log 64 - 5 \log x$
CONDENSE	$\frac{1}{3} \log 64 + 9 \log x + 3 \log y$	CONDENSE	$\frac{2}{3} \log 64 + 4 \log 2 - 7 \log x$		

“CONDENSE” Log Race Game Cards —  
FOR COLOR PRINTER

EXPAND	$\log_7 3\sqrt[3]{x^6}$	EXPAND	$\log_3 5x$	EXPAND	$\log_5 2y$
EXPAND	$\log_6 11y$	EXPAND	$\log_5 9x$	EXPAND	$\log_7 \frac{x}{3}$
EXPAND	$\log_3 \frac{7}{x}$	EXPAND	$\log 11x^2$	EXPAND	$\ln 5x^3$
EXPAND	$\log 7y^{10}$	EXPAND	$\ln 9y^2$	EXPAND	$\ln 5x^8$
EXPAND	$\ln 4x^2$	EXPAND	$\log \frac{x}{2y}$	EXPAND	$\log \frac{9x}{y^7}$
EXPAND	$\ln \frac{6x}{12y^2}$	EXPAND	$\ln \frac{4}{5x}$	EXPAND	$\ln \frac{2x}{4y}$
EXPAND	$\log_2 4\sqrt{y}$	EXPAND	$\log_2 \sqrt[3]{8x^6}$	EXPAND	$\log_5 2\sqrt{x^2 y^3}$



SOLVE	$\log_5(x + 4) + \log_5 x = 1$	SOLVE	$8^x = 32^{x+4}$	SOLVE	$27^{2x} = 81^{x-4}$
SOLVE	$64^{2x-5} = 1024^{x-2}$	SOLVE	$81^{3x+4} = 729^{4x-2}$	SOLVE	$\ln(6x - 12) = \ln(5x - 15)$
SOLVE	$216^{x-5} = 36^{x+3}$	SOLVE	$343^{x+1} = 49^{2x}$	SOLVE	$\ln(11x - 5) = \ln(x + 15)$
SOLVE	$\log(-2x - 1) = \log(9x + 10)$	SOLVE	$\log(2x + 1) = \log(3x - 4)$	SOLVE	$\ln(5x + 8) = \ln(11x - 10)$
SOLVE	$\log_4(10x - 5) = \log_4 55$	SOLVE	$\log_3(7x - 1) = \log_3 13$	SOLVE	$\log_2(8x + 16) = 7$
SOLVE	$\log_7(5x - 7) = 3$	SOLVE	$\log_9(4x + 7) = 2$	SOLVE	$\log_4(2x - 8) = 2$
SOLVE	$\log_5(3x + 10) = 4$	SOLVE	$\log_3 x + \log_3(x - 6) = 3$		

“SOLVE” Log Race Game Cards —  
FOR COLOR PRINTER

REWRITE AS EXP	$\log_3 27 = 3$	REWRITE AS EXP	$\log_9 729 = 3$	REWRITE AS EXP	$\log_4 16 = 2$
REWRITE AS EXP	$\log_{1/9} 81 = -2$	REWRITE AS EXP	$\log_{1/9} \frac{1}{3} = \frac{1}{2}$	REWRITE AS EXP	$\log_{1/9} 3 = -\frac{1}{2}$
REWRITE AS EXP	$\log_2 \frac{1}{4} = -2$	REWRITE AS EXP	$\log_6 1 = 0$	REWRITE AS EXP	$\log 10,000 = 4$
REWRITE AS EXP	$\log \frac{1}{100} = -2$	REWRITE AS EXP	$\log_{12} \frac{1}{144} = -2$	REWRITE AS EXP	$\log_3 81 = 4$
REWRITE AS EXP	$\log_4 64 = 3$	REWRITE AS EXP	$\log_4 4 = 1$	REWRITE AS EXP	$\log_4 2 = \frac{1}{2}$
REWRITE AS EXP	$\log_4 \frac{1}{2} = -\frac{1}{2}$	REWRITE AS EXP	$\log_8 64 = 2$	REWRITE AS EXP	$\log_5 \frac{1}{625} = -4$
REWRITE AS EXP	$\log_{12} \frac{1}{12} = -1$	REWRITE AS EXP	$\log_7 343 = 3$	REWRITE AS EXP	$\log_2 128 = 7$
REWRITE AS EXP	$\log_3 6561 = 8$	<p>“REWRITE AS EXP” Log Race Game Cards —  FOR BLACK AND WHITE PRINTER - PRINT ON  YELLOW PAPER</p>			

REWRITE AS LOG	$6^{-3} = \frac{1}{216}$	REWRITE AS LOG	$7^4 = 2401$	REWRITE AS LOG	$12^2 = 144$
REWRITE AS LOG	$4^{-3} = \frac{1}{64}$	REWRITE AS LOG	$10^3 = 1000$	REWRITE AS LOG	$3^7 = 2187$
REWRITE AS LOG	$7^{-2} = \frac{1}{49}$	REWRITE AS LOG	$\left(\frac{1}{16}\right)^{1/2} = \frac{1}{4}$	REWRITE AS LOG	$\left(\frac{1}{64}\right)^{1/3} = \frac{1}{4}$
REWRITE AS LOG	$\left(\frac{1}{4}\right)^{-1/2} = 2$	REWRITE AS LOG	$\left(\frac{1}{4}\right)^{1/2} = \frac{1}{2}$	REWRITE AS LOG	$\left(\frac{1}{64}\right)^{2/3} = \frac{1}{16}$
REWRITE AS LOG	$\left(\frac{1}{64}\right)^{-2/3} = 16$	REWRITE AS LOG	$11^2 = 121$	REWRITE AS LOG	$3^{-4} = \frac{1}{81}$
REWRITE AS LOG	$4^4 = 256$	REWRITE AS LOG	$4^{-4} = \frac{1}{256}$	REWRITE AS LOG	$256^{1/4} = 4$
REWRITE AS LOG	$256^{-1/4} = \frac{1}{4}$	REWRITE AS LOG	$7^2 = 49$	REWRITE AS LOG	$6^3 = 216$
REWRITE AS LOG	$2^{-3} = \frac{1}{8}$	<p>“REWRITE AS LOG” Log Race Game Cards —  FOR BLACK AND WHITE PRINTER - PRINT ON  BLUE PAPER</p>			

CONDENSE	$9 \log_4 x + 3 \log_4 10 - \frac{1}{3} \log_4 y$	CONDENSE	$2 \ln 11 - 9 \ln y - \frac{1}{2} \ln x$	CONDENSE	$\log 3 + \log 11$
CONDENSE	$\log_3 7 + \log_3 y$	CONDENSE	$\log_5 11 - \log_5 x$	CONDENSE	$\log_3 y - \log_3 4$
CONDENSE	$\log_3 11 + 6 \log_3 x$	CONDENSE	$\frac{1}{2} \log_4 x - 3 \log_4 y$	CONDENSE	$6 \log_4 y + 4 \log_4 x$
CONDENSE	$7 \ln 2 - 3 \ln 4$	CONDENSE	$\ln 11 + 6 \ln x$	CONDENSE	$\ln 8 - 3 \ln x$
CONDENSE	$3 \log 8 + 7 \log x$	CONDENSE	$2 \log_4 9 + 3 \log_4 y - 3 \log_4 x$	CONDENSE	$\log 10 + 4 \log x - \frac{1}{3} \log y$
CONDENSE	$5 \log_3 x - 2 \log_3 12 - 4 \log_3 y$	CONDENSE	$2 \ln 10 + 3 \ln x + 2 \ln y$	CONDENSE	$\frac{1}{2} \log 64 - 5 \log x$
CONDENSE	$\frac{1}{3} \log 64 + 9 \log x + 3 \log y$	CONDENSE	$\frac{2}{3} \log 64 + 4 \log 2 - 7 \log x$		

“CONDENSE” Log Race Game Cards —  
 FOR BLACK AND WHITE PRINTER - PRINT ON GREEN PAPER

EXPAND	$\log_7 3\sqrt[3]{x^6}$	EXPAND	$\log_3 5x$	EXPAND	$\log_5 2y$
EXPAND	$\log_6 11y$	EXPAND	$\log_5 9x$	EXPAND	$\log_7 \frac{x}{3}$
EXPAND	$\log_3 \frac{7}{x}$	EXPAND	$\log 11x^2$	EXPAND	$\ln 5x^3$
EXPAND	$\log 7y^{10}$	EXPAND	$\ln 9y^2$	EXPAND	$\ln 5x^8$
EXPAND	$\ln 4x^2$	EXPAND	$\log \frac{x}{2y}$	EXPAND	$\log \frac{9x}{y^7}$
EXPAND	$\ln \frac{6x}{12y^2}$	EXPAND	$\ln \frac{4}{5x}$	EXPAND	$\ln \frac{2x}{4y}$
EXPAND	$\log_2 4\sqrt{y}$	EXPAND	$\log_2 \sqrt[3]{8x^6}$	EXPAND	$\log_5 2\sqrt{x^2 y^3}$

“EXPAND” Log Race Game Cards —  
 FOR BLACK AND WHITE PRINTER - PRINT ON PINK PAPER

SOLVE	$\log_5(x + 4) + \log_5 x = 1$	SOLVE	$8^x = 32^{x+4}$	SOLVE	$27^{2x} = 81^{x-4}$
SOLVE	$64^{2x-5} = 1024^{x-2}$	SOLVE	$81^{3x+4} = 729^{4x-2}$	SOLVE	$\ln(6x - 12) = \ln(5x - 15)$
SOLVE	$216^{x-5} = 36^{x+3}$	SOLVE	$343^{x+1} = 49^{2x}$	SOLVE	$\ln(11x - 5) = \ln(x + 15)$
SOLVE	$\log(-2x - 1) = \log(9x + 10)$	SOLVE	$\log(2x + 1) = \log(3x - 4)$	SOLVE	$\ln(5x + 8) = \ln(11x - 10)$
SOLVE	$\log_4(10x - 5) = \log_4 55$	SOLVE	$\log_3(7x - 1) = \log_3 13$	SOLVE	$\log_2(8x + 16) = 7$
SOLVE	$\log_7(5x - 7) = 3$	SOLVE	$\log_9(4x + 7) = 2$	SOLVE	$\log_4(2x - 8) = 2$
SOLVE	$\log_5(3x + 10) = 4$	SOLVE	$\log_3 x + \log_3(x - 6) = 3$		

“SOLVE” Log Race Game Cards —  
 FOR BLACK AND WHITE PRINTER - PRINT ON ORANGE PAPER

## Answers for Log Race

### REWRITE AS EXP

$$\begin{aligned}\log_3 27 &= 3 \rightarrow 3^3 = 27 \\ \log_9 729 &= 3 \rightarrow 9^3 = 729 \\ \log_4 16 &= 2 \rightarrow 4^2 = 16 \\ \log_{1/9} 81 &= -2 \rightarrow \left(\frac{1}{9}\right)^{-2} = 81 \\ \log_{1/9} \frac{1}{3} &= \frac{1}{2} \rightarrow \left(\frac{1}{9}\right)^{1/2} = \frac{1}{3} \\ \log_{1/9} 3 &= -\frac{1}{2} \rightarrow \left(\frac{1}{9}\right)^{-1/2} = 3 \\ \log_2 \frac{1}{4} &= -2 \rightarrow 2^{-2} = \frac{1}{4} \\ \log_6 1 &= 0 \rightarrow 6^0 = 1 \\ \log 10,000 &= 4 \rightarrow 10^4 = 10,000 \\ \log \frac{1}{100} &= -2 \rightarrow 10^{-2} = \frac{1}{100} \\ \log_{12} \frac{1}{144} &= -2 \rightarrow 12^{-2} = \frac{1}{144} \\ \log_3 81 &= 4 \rightarrow 3^4 = 81 \\ \log_4 64 &= 3 \rightarrow 4^3 = 64 \\ \log_4 4 &= 1 \rightarrow 4^1 = 4 \\ \log_4 2 &= \frac{1}{2} \rightarrow 4^{1/2} = 2 \\ \log_4 \frac{1}{2} &= -\frac{1}{2} \rightarrow 4^{-1/2} = \frac{1}{2} \\ \log_8 64 &= 2 \rightarrow 8^2 = 64 \\ \log_5 \frac{1}{625} &= -4 \rightarrow 5^{-4} = \frac{1}{625} \\ \log_{12} \frac{1}{12} &= -1 \rightarrow 12^{-1} = \frac{1}{12} \\ \log_7 343 &= 3 \rightarrow 7^3 = 343 \\ \log_2 128 &= 7 \rightarrow 2^7 = 128 \\ \log_3 6561 &= 8 \rightarrow 3^8 = 6561\end{aligned}$$

### REWRITE AS LOG

$$\begin{aligned}7^4 &= 2401 \rightarrow \log_7 2401 = 4 \\ 12^2 &= 144 \rightarrow \log_{12} 144 = 2 \\ 4^{-3} &= \frac{1}{64} \rightarrow \log_4 \frac{1}{64} = -3 \\ 10^3 &= 1000 \rightarrow \log 1000 = 3 \\ 3^7 &= 2187 \rightarrow \log_3 2187 = 7 \\ 7^{-2} &= \frac{1}{49} \rightarrow \log_7 \frac{1}{49} = -2 \\ \left(\frac{1}{16}\right)^{1/2} &= \frac{1}{4} \rightarrow \log_{1/16} \frac{1}{4} = \frac{1}{2} \\ \left(\frac{1}{64}\right)^{1/3} &= \frac{1}{4} \rightarrow \log_{1/64} \frac{1}{4} = \frac{1}{3} \\ \left(\frac{1}{4}\right)^{-1/2} &= 2 \rightarrow \log_{1/4} 2 = -\frac{1}{2} \\ \left(\frac{1}{4}\right)^{1/2} &= \frac{1}{2} \rightarrow \log_{1/4} \frac{1}{2} = \frac{1}{2} \\ \left(\frac{1}{64}\right)^{2/3} &= \frac{1}{16} \rightarrow \log_{1/64} \frac{1}{16} = \frac{2}{3} \\ \left(\frac{1}{64}\right)^{-2/3} &= 16 \rightarrow \log_{1/64} 16 = -\frac{2}{3}\end{aligned}$$

$$\begin{aligned}11^2 &= 121 \rightarrow \log_{11} 121 = 2 \\ 3^{-4} &= \frac{1}{81} \rightarrow \log_3 \frac{1}{81} = -4 \\ 4^4 &= 256 \rightarrow \log_4 256 = 4 \\ 4^{-4} &= \frac{1}{256} \rightarrow \log_4 \frac{1}{256} = -4 \\ 256^{1/4} &= 4 \rightarrow \log_{256} 4 = \frac{1}{4} \\ 256^{-1/4} &= \frac{1}{4} \rightarrow \log_{256} \frac{1}{4} = -\frac{1}{4} \\ 7^2 &= 49 \rightarrow \log_7 49 = 2 \\ 6^3 &= 216 \rightarrow \log_6 216 = 3 \\ 6^{-3} &= \frac{1}{216} \rightarrow \log_6 \frac{1}{216} = -3 \\ 2^{-3} &= \frac{1}{8} \rightarrow \log_2 \frac{1}{8} = -3\end{aligned}$$

### CONDENSE

$$\begin{aligned}\log 3 + \log 11 &\rightarrow \log 33 \\ \log_3 7 + \log_3 y &\rightarrow \log_3 7y \\ \log_5 11 - \log_5 x &\rightarrow \log_5 \frac{11}{x} \\ \log_3 y - \log_3 4 &\rightarrow \log_3 \frac{y}{4} \\ \log_3 11 + 6 \log_3 x &\rightarrow \log_3 11x^6 \\ \frac{1}{2} \log_4 x - 3 \log_4 y &\rightarrow \log_4 \frac{\sqrt{x}}{y^3} \\ 6 \log_4 y + 4 \log_4 x &\rightarrow \log_4 \frac{y^6}{x^4} \\ 7 \ln 2 - 3 \ln 4 &\rightarrow \ln \frac{128}{81} \\ \ln 11 + 6 \ln x &\rightarrow \ln 11x^6 \\ \ln 8 - 3 \ln x &\rightarrow \ln \frac{8}{x^3} \\ 3 \log 8 + 7 \log x &\rightarrow \log 512x^7 \\ 2 \log_4 9 + 3 \log_4 y - 3 \log_4 x &\rightarrow \log_4 \frac{81y^3}{x^3} \\ \log 10 + 4 \log x - \frac{1}{3} \log y &\rightarrow \log \frac{x^4}{\sqrt[3]{y}} \\ 5 \log_3 x - 2 \log_3 12 - 4 \log_3 y &\rightarrow \log_3 \frac{x^5}{144y^4} \\ 2 \ln 10 + 3 \ln x + 2 \ln y &\rightarrow \ln 100x^3y^2 \\ \frac{1}{2} \log 64 - 5 \log x &\rightarrow \log \frac{8}{x^5} \\ \frac{1}{3} \log 64 + 9 \log x + 3 \log y &\rightarrow \log 4x^9y^3 \\ \frac{2}{3} \log 64 + 4 \log 2 - 7 \log x &\rightarrow \log \frac{256}{x^7} \\ 2 \ln 11 - 9 \ln y - \frac{1}{2} \ln x &\rightarrow \ln \frac{121}{y^9\sqrt{x}} \\ 9 \log_4 x + 3 \log_4 10 - \frac{1}{3} \log_4 y &\rightarrow \log_4 \frac{1000x^9}{\sqrt[3]{y}}\end{aligned}$$

### EXPAND

$$\begin{aligned}\log_3 5x &\rightarrow \log_3 5 + \log_3 x \\ \log_5 2y &\rightarrow \log_5 2 + \log_5 y \\ \log_6 11y &\rightarrow \log_6 11 + \log_6 y\end{aligned}$$

$$\begin{aligned}\log_5 9x &\rightarrow \log_5 9 + \log_5 x \\ \log_7 \frac{x}{3} &\rightarrow \log_7 x - \log_7 3 \\ \log_3 \frac{7}{x} &\rightarrow \log_3 7 - \log_3 x \\ \log 11x^2 &\rightarrow \log 11 + 2 \log x \\ \ln 5x^3 &\rightarrow \ln 5 + 3 \ln x \\ \log 7y^{10} &\rightarrow \log 7 + 10 \log y \\ \ln 9y^2 &\rightarrow \ln 9 + 2 \ln y \\ \log 5x^8 &\rightarrow \log 5 + 8 \log x \\ \ln 4x^2 &\rightarrow \ln 4 + 2 \ln x \\ \log \frac{x}{2y} &\rightarrow \log x - \log 2 - \log y \\ \log \frac{9x}{y^7} &\rightarrow \log 9 + \log x - 7 \log y \\ \ln \frac{6x}{12y^2} &\rightarrow \ln 6 + \ln x - \ln 12 - 2 \ln y \\ \ln \frac{4}{5x} &\rightarrow \ln 4 - \ln 5 - \ln x \\ \ln \frac{2x}{4y} &\rightarrow \ln 2 + \ln x - \ln 4 - \ln y \\ \log_2 4\sqrt{y} &\rightarrow 2 + \frac{1}{2} \log_2 y \\ \log_2 \sqrt[3]{8x^6} &\rightarrow 1 + 2 \log_2 x \\ \log_5 2\sqrt{x^2y^3} &\rightarrow \log_5 2 + \log_5 x + \frac{3}{2} \log_5 y \\ \log_7 3\sqrt[3]{x^6} &\rightarrow \log_7 3 + 2 \log_7 x\end{aligned}$$

### SOLVE

$$\begin{aligned}8^x &= 32^{x+4} \rightarrow x = -10 \\ 27^{2x} &= 81^{x-4} \rightarrow x = -8 \\ 64^{2x-5} &= 1024^{x-2} \rightarrow x = 5 \\ 216^{x-5} &= 36^{x+3} \rightarrow x = 21 \\ 343^{x+1} &= 49^{2x} \rightarrow x = 3 \\ 81^{3x+4} &= 729^{4x-2} \rightarrow x = \frac{7}{3} \\ \ln(6x-12) &= \ln(5x-5) \rightarrow x = 7 \\ \ln(11x-5) &= \ln(x+15) \rightarrow x = 2 \\ \log(-2x-1) &= \log(9x+10) \rightarrow x = -1 \\ \log(2x+1) &= \log(3x-4) \rightarrow x = 5 \\ \ln(5x+8) &= \ln(11x-10) \rightarrow x = 3 \\ \log_4(10x-5) &= \log_4 55 \rightarrow x = 6 \\ \log_3(7x-1) &= \log_3 13 \rightarrow x = 2 \\ \log_2(8x+16) &= 7 \rightarrow x = 14 \\ \log_7(5x-7) &= 3 \rightarrow x = 70 \\ \log_9(4x+7) &= 2 \rightarrow x = 18.5 \\ \log_4(2x-8) &= 2 \rightarrow x = 12 \\ \log_5(3x+10) &= 4 \rightarrow x = 205 \\ \log_3 x + \log_3(x-6) &= 3 \rightarrow x = 9 \\ \log_5(x+4) + \log_5 x &= 1 \rightarrow x = 1\end{aligned}$$

