Warm Up

Use the properties of logarithms to rewrite each expression.

- 1. $\log_3(8x^4)$
- $2. \log_2 \left(\frac{5y^6}{x^4} \right)$
- 3. $2 \log x 2 \log y$

$$t = \frac{\log\left(\frac{C}{A}\right)}{\log\left(1 - r\right)}$$

where *t* is the time in hours since the medicine was administered, *C* is the current amount of medicine remaining in the patient's body in milligrams, *A* is the original dose of the medicine in milligrams, and *r* is the rate at which the medicine is metabolized.

1. A patient is given 10 milligrams of medicine which is metabolized at the rate of 20% per hour. How long will it take for 2 milligrams of the medicine to metabolize?

Worked Example

$$4 = \frac{\log\left(\frac{9}{12}\right)}{\log\left(1 - r\right)}$$
 Substitute the values for t , C , and A into the formula.

$$4 \log\left(1 - r\right) = \log\left(0.75\right)$$
 Multiply both sides of the equation by $\log\left(1 - r\right)$.

$$4 \log\left(1 - r\right) \approx -0.125$$
 Evaluate $\log\left(0.75\right)$.

$$\log\left(1 - r\right) \approx -0.03125$$
 Divide both sides of the equation by 4.

$$10^{-0.03125} \approx 1 - r$$
 Rewrite as an exponential equation.

$$r \approx 1 - 10^{-0.03125}$$
 Isolate the variable r .

$$r \approx 0.0694$$

The medicine is metabolized at an approximate rate of 6.94% per hour.

2. Six hours after administering a 20-milligram dose of medicine, 5 milligrams remain in a patient's body. At what rate is the medicine metabolized?

	Example	First rewrite as an exponential equation. Then solve for <i>x</i> .	First apply the Change of Base Formula. Then solve for x.
Argument Is Unknown	$\log_5 x = 3.1$		
Exponent Is Unknown	$\log_8 145 = x$		
Base Is Unknown	$\log_{x} 24 = 6.7$		

5. Circle the logarithmic equations that can be solved more efficiently when rewritten as exponential equations. Draw a box around the equations that can be solved more efficiently by applying the Change of Base Formula. Explain your choice.

a.
$$\log_4(x+3) = \frac{1}{2}$$

b.
$$\log_{4.5} 9 = x - 1$$

c.
$$\log_{x+2} 7.1 = 3$$

d.
$$\log_3 4.6 = 2 - x$$

e.
$$\ln(x + 4) = 3.8$$

f.
$$\log_{11} 12 = x - 7$$

g.
$$\log_{1-x} 8 = 14.7$$

h.
$$\log (4 - x) = 1.3$$

6. Solve each logarithmic equation. Check your work.

a.
$$\log_2 (x^2 - 6x) = 4$$

b.
$$\log_6 (x^2 + x) = 1$$





$$\log 5 + \log x = 2$$

$$log (5 + x) = 2$$

$$10^2 = 5 + x$$

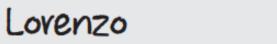
$$95 = x$$

Santiago

$$\log 5 + \log x = 2$$

$$5x = 2$$

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



$$\log 5 + \log x = 2$$

$$5 + x = 2$$

$$x = -3$$





b. Solve $\log 5 + \log x = 2$. Check your work.

2. Solve each logarithmic equation. Check your work.

a.
$$\log_5 45x - \log_5 3 = 1$$

b.
$$\log_2 8 + 3 \log_2 x = 6$$

c.
$$\ln 18x - \ln 6 = 2$$

3. Pippa and Kate disagree about the solution to the logarithmic equation $log_{\xi} x^2 - log_{\xi} 4 = 2$.



$$\log_{5} x^{2} - \log_{5} 4 = 2$$

$$\log_{5} \left(\frac{x^{2}}{4}\right) = 2$$

$$5^{2} = \frac{x^{2}}{4}$$

$$25 = \frac{x^{2}}{4}$$

$$100 = x^{2}$$

$$x = 10, -10$$

Kate says the solutions are x = 10, x = -10. Pippa says that the solution x = -10 should be rejected because the argument of a logarithm must be greater than zero.

Who is correct? Explain your reasoning.

4. Solve $\log_3 (x - 4) + \log_3 (x + 2) = 3$. Check your work.

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Elijah



$$2 \log 6 = \log x - \log 2$$

$$\log (6^2) = \log \left(\frac{x}{2}\right)$$

$$36 = \frac{x}{2}$$

$$72 = x$$

Check:

2 log
$$6 \stackrel{?}{=} \log 72 - \log 2$$

log $(6^2) \stackrel{?}{=} \log \left(\frac{72}{2}\right)$
log $36 = \log 36$

Zander



$$2 \log 6 = \log x - \log 2$$

$$\log (6^2) - \log x + \log 2 = 0$$

$$\log \left(\frac{36}{x}\right) + \log 2 = 0$$

$$\log \left(\frac{72}{x}\right) = 0$$

$$\frac{72}{x} = 10^{\circ}$$

$$\frac{72}{x} = 1$$

$$72 = x$$

Check:

$$2 \log 6 \stackrel{?}{=} \log 72 - \log 2$$

 $\log (6^2) \stackrel{?}{=} \log (\frac{72}{2})$
 $\log 36 = \log 36$