Just a Reminder:

Green registration papers are due March 20th.

(Tell me what class you are registering for next year and have your parent/guardian sign it!)

Just a Reminder:

Hall Passes and Late Passes are due March 21st.

Lesson 47: Solving Log Equations

By the end of the lesson, we will be able to:

~ Solve log equations

~ Solve equations with more than one log

Lesson 47: Solving Log Equations

One way to solve log equations is to rewrite in exponential form. We use this method when there is log expression on one side of the equation, and a number on the other side.

Converting between exponential and log form:

$$\boxed{\textit{If } \log_b x = y, \quad \textit{then } b^y = x}$$

Lesson 47: Solving Log Equations

Examples: Convert to exponent form and solve.

a.) $\log_6 x = 2$

$6^2 = x$

$\boxed{36 = x}$

b.) $\log_4(3x) = 3$

$4^3 = 3x$

$\frac{64}{3} = \frac{3x}{3}$

$\boxed{x = \frac{64}{3} \text{ or } 21\frac{1}{3}}$

Examples: Convert to exponent form and solve.

c.) $5 + 2\ln x = 9$

$-5 \qquad -5$

$\frac{2\ln x}{2} = \frac{4}{2}$

$\ln x = 2$

$\boxed{e^2 = x}$

If there is more than one log expression in the equation, the logs must first be condensed.

Example: $\log_2 x + 4\log_2 3 = 4$

$\log_2 (x \cdot 3^4) = 4$

$\log_2 (81x) = 4$

$2^4 = 81x$

$\frac{16}{81} = \frac{81x}{81}$

$\boxed{x = \frac{16}{81}}$

Lesson 47: Solving Log Equations

Important!!!

answers.

Always Check Your Solutions!

Some solutions may be extraneous.

A solution is **extraneous** if...

<u>**Lesson 47: Solving Log Equations**</u>

A solution is **extraneous** if...

it is a solution of the simplified form of an equation that **does not satisfy the original equation.**

inside (argument) of log cannot be zero or negative

"Sheep"

Examples: Condense and solve.

a.) $\log(x + 2) + \log(x - 1) = 1$

$\log((x+2)(x-1)) = 1$

$\log_{10}(x^2+x-2) = 1$

$10^1 = x^2+x-2$

$-10 \qquad\qquad -10$

$0 = x^2+x-12$

$0 = (x+4)(x-3)$

$x+4=0 \qquad x-3=0$

$\boxed{\cancel{x=-4} \qquad x=3}$

Check: $\cancel{x=-4}$

$\log(-4+2)+\log(-4-1)=1$

$\log(-2)+\log(-5)=1$

X neg $\qquad$ X neg

Check: $x=3$

$\log(3+2)+\log(3-1)=1$

$\log(5)+\log(2)=1$ ✓ ✓

$\log(10)=1$ ✓

Lesson 47: Solving Log Equations

Examples: Condense and solve.

b.) $\log_5(4x+7) - \log_5 x = 2$

$\log_5\left(\frac{4x+7}{x}\right) = 2$

$5^2 = \frac{4x+7}{x}$

$(x)25 = \frac{4x+7}{\cancel{x}}(\cancel{x})$

$25x = 4x+7$
$-4x \quad -4x$

$\frac{21x}{21} = \frac{7}{21}$

$\boxed{x = \frac{1}{3}}$

Check: ✓

$\log_5\left(4\left(\frac{1}{3}\right)+7\right) - \log_5\left(\frac{1}{3}\right) = 2$ ✓ ✓

Lesson 47: Solving Log Equations

Another way to solve log equations is to use the following property of equality:

Property of equality for log functions:

$$\text{If } \log_{\underline{b}} x = \log_{\underline{b}} y, \text{ then } x = y$$

If there is a single log on both sides, with the same base, then the arguments can be set equal.

Examples:

a.) $\log_3(3x-5)=\log_3(x+7)$

$3x - \cancel{5} = \cancel{x} + 7$

$-x \quad +5 \qquad -\cancel{x} \quad +5$

$\frac{2x}{2} = \frac{12}{2}$

$\boxed{x=6}$

Check: $x=6$ ✓

$\log_3(3(6)-5) = \log_3(6+7)$ ✓ ✓

Examples:

b.) $\log(x^2 - 6) = \log x$

$$x^2 - 6 = x$$
$$-x \quad -x$$
$$x^2 - x - 6 = 0$$
$$(x-3)(x+2) = 0$$
$$x - 3 = 0 \qquad x + 2 = 0$$
$$\boxed{x = 3 \qquad \cancel{x = -2}}$$

Check: $\cancel{x = -2}$

$$\log((-2)^2 - 6) = \log(-2)$$
$$4 - 6$$
$$\log(-2) = \log(-2)$$

Check: $x = 3$ ✓

$$\log(3^2 - 6) = \log(3)$$
$$9 - 6$$
$$\log(3) = \log(3) \checkmark$$

If there is more than one log expression in the equation, the logs must first be condensed.

Examples:

a.) $\ln(x-2)+\ln(2x-3)=2\ln x$

$\ln\left((x-2)(2x-3)\right)=\ln(x^2)$

$\ln\left(2x^2-7x+6\right)=\ln(x^2)$

$$\begin{array}{r} 2x^2-7x+6=x^2 \\ -x^2 \qquad\qquad\quad -x^2 \\ \hline x^2-7x+6=0 \end{array}$$

$(x-1)(x-6)=0$

Examples: work continued...

a.) $\ln(x-2) + \ln(2x-3) = 2\ln x$

$(x-1)(x-6) = 0$

$x-1=0 \qquad x-6=0$

$\boxed{\cancel{x=1} \qquad x=6}$

Check: $\cancel{x=1}$

$\ln(1-2) + \ln(2(1)-3) = 2\ln(1)$

✗ ✗ ✓

Check: $x=6$ ✓

$\ln(6-2) + \ln(2(6)-3) = 2\ln(6)$

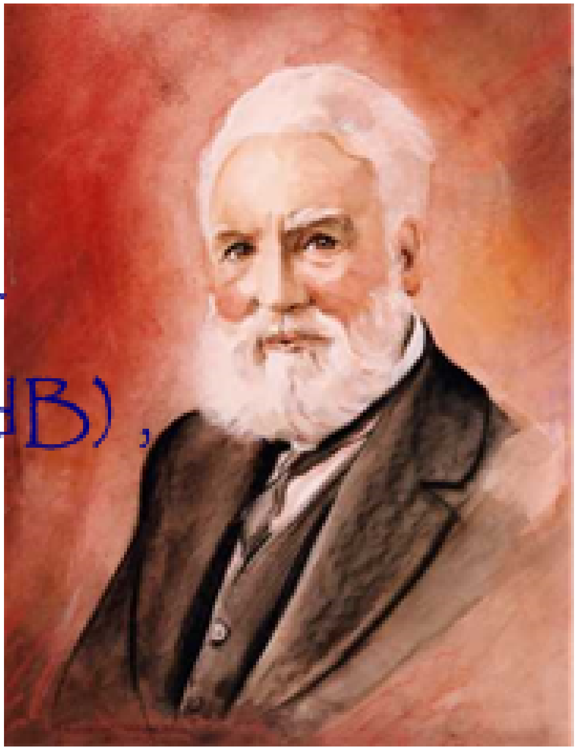
✓ ✓ ✓

Examples:

b.) $\log_2(x+3) - \log_2(2x-1) = \log_2 2$

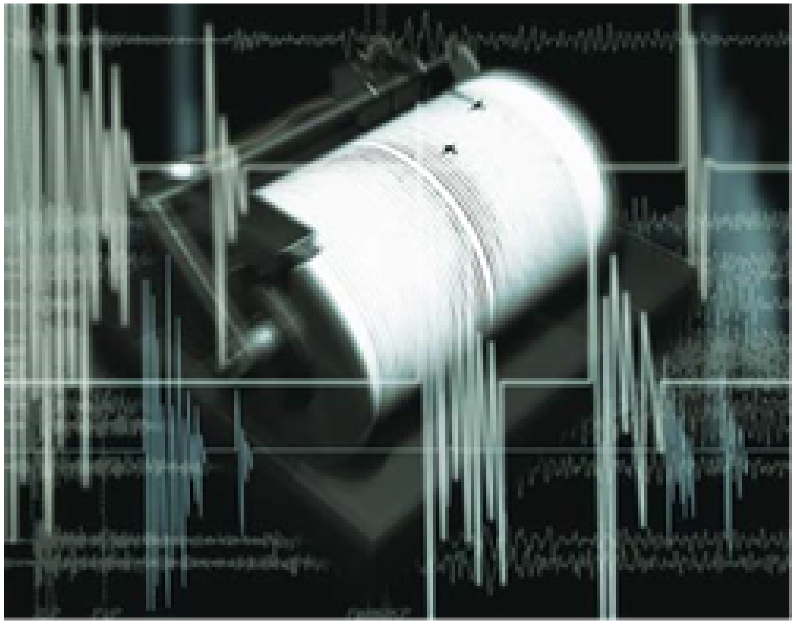
When are logs used?

The bel (symbol B) is a unit of measure which is the base -10 logarithm of ratios, such as power levels and voltage levels. It is mostly used in telecommunication, electronics, and acoustics. The Bel is named after telecommunications pioneer Alexander Graham Bell. The decibel (dB) , equal to 0.1 bel, is more commonly used.



When are logs used?

The Richter scale measures earthquake intensity on a base -10 logarithmic scale.

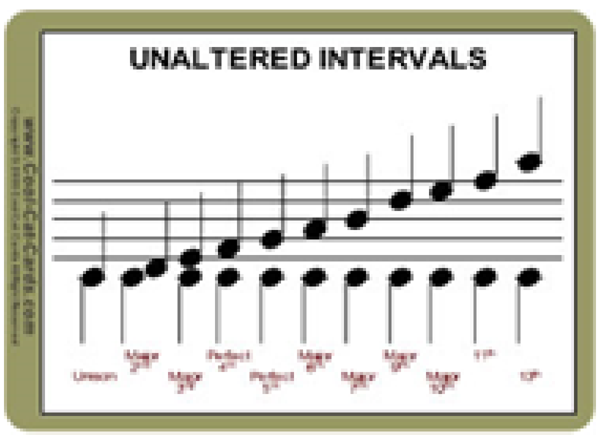


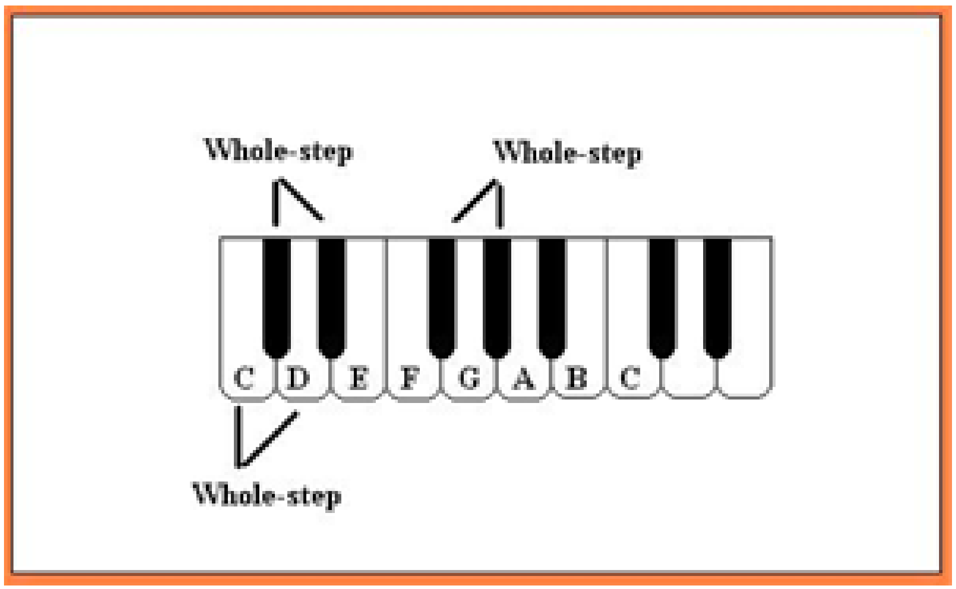
When are logs used?

In astronomy, the apparent magnitude measures the brightness of stars logarithmically, since the eye responds approximately logarithmically to brightness.

When are logs used?

Musical intervals are measured logarithmically as semitones (half steps up or down).





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By the end of the lesson, we will be able to:

~ Solve log equations

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Homework:

Assignment 47