

<p><b>Using Common log (log base 10) to solve equations with unknown exponents</b>                  Example <math>15 = 3 \cdot 4^x</math>  <math>\rightarrow 5 = 4^x</math> (this is where math teachers use defn. of log)  <math>\rightarrow \log(5) = \log(4^x)</math>  <math>\rightarrow \log(5) = x \log 4</math>  <math>\rightarrow \frac{\log(5)}{\log 4} = \frac{x \log 4}{\log 4}</math>  <math>x = \frac{\log(5)}{\log 4} = \log_4 5 \approx 1.1609640474437</math></p>	<p><b>Using Natural log (log base e) to solve equations with unknown exponents</b>                  Example <math>15 = 3 \cdot 4^x</math>  <math>\rightarrow 5 = 4^x</math>  <math>\rightarrow \ln(5) = \ln(4^x)</math>  <math>\rightarrow \ln(5) = x \ln 4</math>  <math>\rightarrow \frac{\ln(5)}{\ln 4} = \frac{x \ln 4}{\ln 4}</math>  <math>x = \frac{\ln(5)}{\ln 4} \approx 1.1609640474437</math></p>
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Solve  $36 = 9 \left(\frac{3}{4}\right)^x$  using common log (log no base on calculator (actual base 10)) and natural log (ln on calculator (actual base e))

<p><math>4 = \frac{3}{4}^x</math>  <math>\log 4 = \log \frac{3}{4}^x</math>  <math>\log 4 = x \log \frac{3}{4}</math>  <math>x = \frac{\log 4}{\log \frac{3}{4}} \approx -4.819</math></p>	<p><math>4 = \frac{3}{4}^x</math>  <math>\ln 4 = \ln \frac{3}{4}^x</math>  <math>\ln 4 = x \ln \frac{3}{4}</math>  <math>x = \frac{\ln 4}{\ln \frac{3}{4}} \approx -4.819</math></p>
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Solve  $450 = 18 \left(\frac{5}{4}\right)^x$  using common log (log no base on calculator (actual base 10)) and natural log (ln on calculator (actual base e))

<p><math>\frac{450}{18} = \frac{5}{4}^x</math>  <math>\log \left(\frac{450}{18}\right) = \log \frac{5}{4}^x</math>  <math>\frac{\log \left(\frac{450}{18}\right)}{\log \left(\frac{5}{4}\right)} = x</math>  <math>x = 11.425</math></p>	<p><math>\frac{450}{18} = \frac{5}{4}^x</math>  <math>\ln \left(\frac{450}{18}\right) = \ln \left(\frac{5}{4}\right)^x</math>  <math>x \ln \frac{5}{4} = \ln \left(\frac{450}{18}\right)</math>  <math>x = \frac{\ln \left(\frac{450}{18}\right)}{\ln \left(\frac{5}{4}\right)} \approx 11.425</math></p>
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Solve  $9600 = 1600(1.045)^{2x}$  using common log (log no base on calculator (actual base 10)) and natural log (ln on calculator (actual base e))

$6 = 1.045^{2x}$ $\log 6 = \log 1.045^{2x}$ $\log 6 = 2x \log 1.045$ $2x = \frac{\log 6}{\log 1.045} \approx 20.353$	$6 = 1.045^{2x}$ $\ln(6) = \ln(1.045)^{2x}$ $\ln 6 = 2x (\ln 1.045)$ $\frac{\ln 6}{\ln 1.045} = 2x \quad x = \frac{\ln 6}{2 \ln 1.045}$ $x \approx 20.353$
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Solve  $9600 = 1600(e)^{0.09x}$  using common log (log no base on calculator (actual base 10)) and natural log (ln on calculator (actual base e))

$6 = e^{0.09x}$ $\log 6 = \log e^{0.09x}$ $\log 6 = 0.09x \log e$ $\frac{\log 6}{\log e} = 0.09x$ $x = \frac{\log 6}{\frac{\log e}{0.09}} \approx 19.908$	$6 = e^{0.09x}$ $\ln 6 = \ln e^{0.09x}$ $\ln 6 = 0.09x \ln e$ $\frac{\ln 6}{\ln e} = 0.09x$ $x = \frac{\ln 6}{\frac{\ln e}{0.09}} \approx 19.908$
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Solve  $7500 = 1500(1.024)^{52x}$  using common log (log no base on calculator (actual base 10)) and natural log (ln on calculator (actual base e))

$5 = 1.024^{52x}$ $\log 5 = \log 1.024^{52x}$ $\log 5 = 52x \log 1.024$ $\frac{\log 5}{\log 1.024} = 52x$ $x = \frac{\log 5}{\frac{\log 1.024}{52}} \approx 1.308$	$5 = 1.024^{52x}$ $\ln 5 = \ln 1.024^{52x}$ $\ln 5 = 52x (\ln 1.024)$ $\frac{\ln 5}{\ln 1.024} = 52x$ $x = \frac{\ln 5}{\frac{\ln 1.024}{52}} \approx 1.308$
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Solve  $7500 = 1500(e)^{1.248x}$  using common log (log no base on calculator (actual base 10)) and natural log (ln on calculator (actual base e))

$5 = e^{1.248x}$ $\ln 5 = \ln e^{1.248x}$ $\ln 5 = 1.248x \ln e$ $\frac{\ln 5}{\ln e} = 1.248x$ $x = \frac{\ln 5}{\frac{\ln e}{1.248}} \approx 1.290$	$5 = e^{1.248x}$ $\log 5 = \log e^{1.248x}$ $\log 5 = 1.248x \log e$ $\frac{\log 5}{\log e} = 1.248x$ $x = \frac{\log 5}{\frac{\log e}{1.248}} \approx 1.290$
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**Using Common log (log base 10) to solve equations with unknown exponents**

Example  $15 = 3 \cdot 4^x$

$\rightarrow 5 = 4^x$  (this is where math teachers use defn. of log)

$\rightarrow \log(5) = \log(4^x)$

$\rightarrow \log(5) = x \log 4$

$\rightarrow \frac{\log(5)}{\log 4} = \frac{x \log 4}{\log 4}$

$x = \frac{\log(5)}{\log 4} = \log_4 5 \approx 1.1609640474437$

**Using Natural log (log base e) to solve equations with unknown exponents**

Example  $15 = 3 \cdot 4^x$

$\rightarrow 5 = 4^x$

$\rightarrow \ln(5) = \ln(4^x)$

$\rightarrow \ln(5) = x \ln 4$

$\rightarrow \frac{\ln(5)}{\ln 4} = \frac{x \ln 4}{\ln 4}$

$x = \frac{\ln(5)}{\ln 4} \approx 1.1609640474437$

Solve  $16 = 8 \left(\frac{2}{3}\right)^x$  using common log (log no base on calculator (actual base 10)) and natural log (ln on calculator (actual base e))

$2 = \frac{2}{3}^x$ $\log 2 = \log \frac{2}{3}^x$ $\log 2 = x \log \frac{2}{3}$ $x = \frac{\log 2}{\log \frac{2}{3}} \approx -1.710$	$2 = \frac{2}{3}^x$ $\ln 2 = \ln \frac{2}{3}^x$ $\ln 2 = x \ln \frac{2}{3}$ $x = \frac{\ln 2}{\ln \frac{2}{3}} \approx -1.710$
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**Using Common log (log base 10) to solve equations with unknown exponents**

Example  $15 = 3 \cdot 4^x$

$\rightarrow 5 = 4^x$  (this is where math teachers use defn. of log)

$\rightarrow \log(5) = \log(4^x)$

$\rightarrow \log(5) = x \log 4$

$\rightarrow \frac{\log(5)}{\log 4} = \frac{x \log 4}{\log 4}$

$x = \frac{\log(5)}{\log 4} = \log_4 5 \approx 1.1609640474437$

**Using Natural log (log base e) to solve equations with unknown exponents**

Example  $15 = 3 \cdot 4^x$

$\rightarrow 5 = 4^x$

$\rightarrow \ln(5) = \ln(4^x)$

$\rightarrow \ln(5) = x \ln 4$

$\rightarrow \frac{\ln(5)}{\ln 4} = \frac{x \ln 4}{\ln 4}$

$x = \frac{\ln(5)}{\ln 4} \approx 1.1609640474437$

Solve  $32 = 4 \left(\frac{3}{2}\right)^x$  using common log (log no base on calculator (actual base 10)) and natural log (ln on calculator (actual base e))

$8 = \left(\frac{3}{2}\right)^x$ $\log 8 = \log \left(\frac{3}{2}\right)^x$ $\log 8 = x \log \frac{3}{2}$ $x = \frac{\log 8}{\log \frac{3}{2}} \approx 5.129$	$8 = \left(\frac{3}{2}\right)^x$ $\ln 8 = \ln \frac{3}{2}^x$ $\ln 8 = x \ln \frac{3}{2}$ $x = \frac{\ln 8}{\ln \frac{3}{2}} \approx 5.129$
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Solve  $3200 = 400(1.025)^{4x}$  using common log (log no base on calculator (actual base 10)) and natural log (ln on calculator (actual base e))

$8 = 1.025^{4x}$ $\log 8 = \log 1.025^{4x}$ $\log 8 = 4x \log 1.025$ $\frac{\log 8}{\log 1.025} = 4x \quad x = \frac{\log 8}{\frac{4 \log 1.025}{4}}$ $x \approx 21.053$	$8 = 1.025^{4x}$ $\ln 8 = \ln 1.025^{4x}$ $\ln 8 = 4x \ln 1.025$ $\frac{\ln 8}{\ln 1.025} = 4x \quad x = \frac{\ln 8}{\frac{4 \ln 1.025}{4}}$ $x \approx 21.053$
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Solve  $3200 = 400(e)^{0.10x}$  using common log (log no base on calculator (actual base 10)) and natural log (ln on calculator (actual base e))

$8 = e^{0.10x}$ $\ln 8 = \ln e^{0.10x}$ $\ln 8 = 0.10x \ln e'$ $\frac{\ln 8}{\ln e'} = 0.10x$ $x = \frac{\ln 8}{\frac{\ln e'}{0.1}}$ $x \approx 20.794$	$8 = e^{0.10x}$ $\log 8 = \log e^{0.10x}$ $\log 8 = 0.10x \log e'$ $\frac{\log 8}{\log e'} = 0.10x$ $x = \frac{\frac{\log 8}{\log e'}}{0.1} = 20.794$
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Solve  $4800 = 600(1.052)^{12x}$  using common log (log no base on calculator (actual base 10)) and natural log (ln on calculator (actual base e))

$8 = 1.052^{12x}$ $\log 8 = \log 1.052^{12x}$ $\log 8 = 12x \log 1.052$ $\frac{\log 8}{\log 1.052} = 12x$ $x = \frac{\frac{\log 8}{\log 1.052}}{12} \approx 3.418$	$8 = 1.052^{12x}$ $\ln 8 = \ln 1.052^{12x}$ $\ln 8 = 12x \ln 1.052$ $\frac{\ln 8}{\ln 1.052} = 12x$ $x = \frac{\frac{\ln 8}{\ln 1.052}}{12} \approx 3.418$
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Solve  $4800 = 600(e)^{0.624x}$  using common log (log no base on calculator (actual base 10)) and natural log (ln on calculator (actual base e))

$8 = e^{0.624x}$ $\ln 8 = \ln e^{0.624x}$ $\ln 8 = 0.624x \ln e'$ $\frac{\ln 8}{\ln e'} = 0.624x$ $x = \frac{\frac{\ln 8}{\ln e'}}{0.624} \approx 3.332$	$8 = e^{0.624x}$ $\log 8 = \log e^{0.624x}$ $\log 8 = 0.624x \log e'$ $\frac{\log 8}{\log e'} = 0.624x$ $x = \frac{\frac{\log 8}{\log e'}}{0.624} \approx 3.332$
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