10. $\log\left(\frac{x^4}{\sqrt[3]{(x-1)}}\right)$

$\log x^4 - \log \sqrt[3]{x-1} \rightarrow (x-1)^{\frac{1}{3}}$

$4\log x - \frac{1}{3}\log(x-1)$

15. $18\log\sqrt{x} + 9\log\sqrt[3]{x} - \log 10$

$\log\sqrt{x}^{18} + \log\sqrt[3]{x}^{9} - \log 10$

$\log x^{\frac{1}{2}\cdot 18} + \log x^{\frac{1}{3}\cdot 9}$

$\log x^9 + \log x^3 - \log 10$

$\log(x^9 \cdot x^3) - \log 10$

$\frac{\log(x^9 \cdot x^3)}{10}$

$\log \frac{x^{12}}{10}$

9. $\log_5(x^2 \cdot \sqrt{x^2+1})$

$\log_5 x^2 + \log_5 \sqrt{x^2+1}$

$\log_5 x^2 + \log_5 (x^2+1)^{1/2}$

$2\log_5 x + \frac{1}{2}\log_5(x^2+1)$

$10^x = 100 \quad \ln x = 5$

# 8-3 Solving Exponential and Logarithmic equations

Objectives:

- I can solve exponential and logarithmic equations

$\log_b a = x$ $\quad\Leftrightarrow\quad$ $b^x = a$

$b^x = a$ $\quad\Leftrightarrow\quad$ $\log_b a = x$

## Solving Graphically

$$275e^{0.06x} = 1000$$

$y_1 = 275e^{.06x}$ $\qquad$ $y_2 = 1000$

$x = 21.51$

Solve the following equation graphically

$10^{2x} = 10^{4}$

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

$x = 2$

extra example

$4e^{0.1x} = 60$

27.08

Solving Equations Algebraically

- re-write in logarithmic/exponential form

- use the property of equality for logarithmic equations

$\log_b a = x$ $\quad b^x$

$a = b^x$

$\log_b a = b^x$

$\log_b a = x$

## Solve the following equations

base-exp

2 decimals

$10 = 5e^{4x}$

$\frac{10}{5} = \frac{5e^{4x}}{5}$

$\ln 2 = \ln e^{4x}$

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

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

$x = 0.17$

$5^x - 4 = 7$

$+4 \quad +4$

$\log_5 5^x = \log_5 11$

$x = \log_5 11$

$\frac{\log 11}{\log 5}$

$x = 1.49$

## Solve the following equations

$2e^{x-1} + 5 = 80$

$-5 \quad -5$

$\frac{2e^{x-1}}{2} = \frac{75}{2}$

$\ln e^{x-1} = \ln \frac{75}{2}$

$x - 1 = \ln \frac{75}{2}$

$+1 \quad +1$

$x = \ln\left(\frac{75}{2}\right) + 1$

$x = 4.62$

$6^{3x} = 12$

$\log_6 \quad \log_6$

$\frac{3x}{3} = \frac{\log_6 12}{3}$

$x = \frac{(\log_6 12)}{3}$

$x = \left(\frac{\log 12}{\log 6}\right) \div 3$

$x = 0.46$

Suppose that $250 is deposited into an account that pays 4.5% compounded quarterly. Solve for $t$ to find how long it will take for the account to contain at least $500.

$A(t) = P\left(1 + \frac{r}{n}\right)^{nt}$

$500 = 250\left(1 + \frac{.045}{4}\right)^{4t}$

$\frac{500}{250} = \frac{250(1.01125)^{4t}}{250}$

$\log_{1.01125} 2 = \frac{\log 1.01125^{4t}}{\log}$

$\left(\frac{\log_{1.01125} 2}{4}\right) = \frac{4t}{4}$

$t = 15.49$ years

How long will it take to triple a $250 initial investment in an account that pays 4.5% compounded quarterly?

Solve the following

$$\ln(x+12) = 3\ln 2$$

Solve the following

$\log x^4 = 2$

$10^{\log x^4} = 10^2$

$x^4 = 10^2$

$\sqrt[4]{x^4} = \sqrt[4]{100}$

$x = \sqrt[4]{100}$

$x = 100^{\frac{1}{4}}$

$x = 3.16$

$\sqrt{x^2}$ $\sqrt[3]{x^3}$ $\sqrt[4]{x^4}$

$\sqrt{x} = x^{\frac{1}{2}}$ $\sqrt[3]{x} = x^{\frac{1}{3}}$ $\sqrt[4]{x} = x^{\frac{1}{4}}$

$4\ln(x+7) - 5 = 1$

$+5 \quad +5$

$\frac{4\ln(x+7)}{4} = \frac{6}{4}$

$e^{\ln(x+7)} = e^{\frac{3}{2}}$

$x+7 = e^{\frac{3}{2}}$

$-7 \quad -7$

$x = e^{\frac{3}{2}} - 7$

$x = -2.52$

Solve the following

$3 - \log(x+2) = 5$

$\log_4(1-x) = 1$

$4^{\log_4(1-x)} = 4^1$

$1 - x = 4^1$

$1 - x = 4$

$-1 \quad -1$

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

$x = -3$

## Solve the following

$$\log(x-2)+\log(x+7)=3\log 4$$

## Comparing Earthquake intensities:

On the Richter scale, the magnitude M of an earthquake depends on the amount of energy, E (measured in ergs), released by the earthquake as follows:

$$M=\frac{2}{3}\log\frac{E}{10^{11.8}}$$

How many times more severe is a 7.4 quake than a 5.5 quake?