

## **Happy Introduce a Girl to Engineering Day!**

- Park your phones
- Grab your calculators
- Start the warm up (on circle table)
- Take out HW

*Compound Interest, Log Properties*

Given  $A(t) = 142e^{0.07t}$

growth

Pert

Find the rate? 7%

Initial Value? 142

Given  $A(t) = 42 \left(1 + \left(\frac{.96}{4}\right)\right)^{4t}$

growth

Comp.Int.

Find the rate? 96%

Initial Value? 42

compound quarterly

Which formula and why? DO NOT SOLVE!

1. Ashleigh wants to double her money. She put \$5,000 in a bank account that pays 4% compounded continuously.

Pert

2. Martha makes an investment of \$500 in an account that pays 6% interest compounded monthly.

Compound interest

3. If the population of a country is growing at a rate of 2.2% compounded annually, how long will it take the population of 60,000 people to double?

$ab^x$

4. The population of a certain species of fish has a relative growth rate of 1.2% per year. It is estimated that the population in the year 2000 was 12 million

Nert

5. Find a bank account balance if the account starts with \$100, has an annual rate of 4%, and the money left in the account for 12 years

$ab^x$

$P e^{rt} / N_0 e^{rt}$

$a b$   
↑  
 $(1-r)$   
 $(1+r)$

Exponentials  $\leftrightarrow$  Logarithms  
 inverses }  $\ln \rightarrow \log_e$   
 $\ln e \rightarrow \log_e e = x$   
 $e^x = e^1$   
 $x = 1$

\* wait until the end to take logs in calc.

Solving Exponential Equations with Logarithms

1.  $2^x - 5 = 30$   
 $\log 2^x = \log 35$   $x \approx 5.13$   
 $x \cdot \log 2 = \frac{\log 35}{\log 2}$   
 $x = \frac{\log 35}{\log 2}$

2.  $(\frac{3}{4})^x = \frac{27}{64}$   
 $\log (\frac{3}{4})^x = \log (\frac{27}{64})$   
 $x \cdot \log (\frac{3}{4}) = \frac{\log (\frac{27}{64})}{\log (\frac{3}{4})}$

3.  $5e^{(x-2)} + 4 = 104$   
 $\frac{5e^{x-2}}{5} = \frac{100}{5}$   
 $\ln e^{x-2} = \ln 20$   
 $(x-2) \cdot 1 = \ln 20$   
 $x = \ln 20 + 2$   
 $x \approx 5$

4.  $7 - 2e^x = 5$   $x = 3$   
 $-2e^x = -2$   
 $\frac{-2e^x}{-2} = \frac{-2}{-2}$   
 $\ln e^x = \ln 1$

5. Suppose a population is growing according to the model  $P = 800e^{0.05t}$ , where  $t$  is given in years.  
 (a) What is the initial size of the population?  
 (b) How long will it take this population to double?  $t = ?$

$x \cdot \ln e = \ln 1$   
 $x = \ln 1$   
 $x = 0$

$1600 = 800e^{0.05t}$   
 $2 = e^{0.05t}$   
 $\ln 2 = \ln e^{0.05t}$   
 $\ln 2 = 0.05t$   
 $13.86 = t$

6. Find out how long it will take \$1500 to triple in value if it is invested at 12% interest, compounded quarterly.

$A(t) = 1500(1 + (\frac{.12}{4}))^{4t}$   
 $4500 = 1500(1 + .03)^{4t}$   
 $\frac{4500}{1500} = \frac{1500}{1500}(1.03)^{4t}$   
 $3 = (1.03)^{4t}$   
 $\ln 3 = 4t \cdot \ln 1.03$   
 $\frac{\ln 3}{4 \ln 1.03} = \frac{4t}{4 \ln 1.03}$   
 $9.29 = t$

Solving Exponential Equations Using Logarithms

Use the properties of logarithms to solve the exponential equations.

1)  $2^x = 45$

2)  $3^x = 3.6$

3)  $10^{2y} = 52$

4)  $7^{3y} = 126$

5)  $3^{x+4} = 6$

6)  $10^{x+6} = 250$

$$\log_7 7^{3y} = \log_7 126$$

$$3y = \log_7 126$$

7)  $3e^x = 42$

8)  $\frac{1}{4}e^x = 5$

9)  $\frac{1}{2}e^{3x} = 20$

10)  $250(1.04)^x = 1000$

11)  $300e^{\frac{x}{2}} = 9000$

12)  $1000^{0.12x} = 25000$

13)  $\frac{1}{5}(4^{x+2}) = 300$

14)  $6 + 2^{x-1} = 1$

15)  $7 + e^{2-x} = 28$

16)  $8 - 12e^{-x} = 7$

17)  $4 + e^{2x} = 10$

18)  $32 + e^{7x} = 46$

19)  $23 - 5e^{x+1} = 3$

20)  $4\left(1 + e^{\frac{x}{3}}\right) = 84$

23) The population  $P$  of a city is given by the function  $P = 2500e^{kt}$ , where  $t = 0$  represents the year 1990. In 1945 the population was 1350. Find the value of  $k$ , and use this value to predict the population in the year 2010.

Solve each equation

24.  $4^{1-2x} = 2$

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

$$1.46x = x + 2$$

27.  $e^{1-x} = 5$

$$(2^2)^{1-2x} = 2^1$$

$$2 - 4x = 1$$

$$25. 5^x = 3^{x+2}$$

$$\frac{x+2}{\log 5} = \frac{x}{\log 3}$$

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

$$x \approx 4.30$$

26.  $9^{2x} = 27^{3x-4}$

$$(3^2)^{2x} = (3^3)^{(3x-4)}$$


$$3^{4x} = 3^{9x-12}$$

$$4x = 9x - 12$$

$$\frac{12}{5} = x$$

### Logarithmic Equations Maze

**Directions:** Find the solution to each equation to “find the log” and solve the maze. SHOW YOUR WORK!

START: $\log_3 81 = x$	$\log_{27} x = \frac{1}{3}$	$\log_5 x = 2$	$\log_{32} x = \frac{1}{5}$
5	3	25	
4	-4	64	-64
$\log_8 x = \frac{1}{3}$	$\log_4 x = 3$	$\log_9 x = \frac{1}{2}$	$\log 0.01 = x$
2	12	3	
-2	-9	10	6
$\log_{\frac{1}{3}} x = -2$	$\log_4 256 = x$	$\log_3 x = -2$	$\log_{\frac{1}{5}} x = 2$
4	$\frac{1}{9}$	32	
9	$\frac{1}{9}$	5	-9
$\log_{16} x = \frac{1}{4}$	$\log_2 64 = x$	$\log_{\sqrt{5}} 5 = x$	STOP! 
2	6	2	

# SNOW BALL FIGHT!

$$\begin{aligned} \log_{\sqrt{5}} 5 &= x \\ (5^{\frac{1}{2}})^x &= 5^1 \\ \frac{1}{2}x &= 1 \\ \boxed{x=2} \end{aligned}$$

$$\begin{aligned} \sqrt{5}^x &= 5 \\ (5^{\frac{1}{2}})^x &= 5 \\ \underbrace{5^{\frac{1}{2}x}} &= \underbrace{5^1} \\ \frac{1}{2}x &= 1 \end{aligned}$$