

Warm-Up:

1. Solve. $\ln(3x + 7) + \ln(6) = \ln(186)$

$$\ln 18x + 42 = \ln 186$$

$$18x + 42 = 186$$

$$18x = 144 \quad x = 8$$

3. $\ln x + \ln 5x = 11$

$$\ln 5x^2 = 11$$

$$e^{11} = 5x^2$$

$$\sqrt{\frac{e^{11}}{5}} \quad x = 109.43$$

4. $2e^x - 1 = 7$

$$2e^x = 8$$

$$e^x = 4$$

$$x = \ln 4$$

$$x = 1.39$$

5. Graph $y = 3(1.3)^x$ and $y = 3(0.3)^x$. What is the same? What is different?

Same: y int 3

DIFF: 1st one

2nd one

Key Concept:

$$y = a(b^x)$$

 a represents the initial valueIf $a > 0$ and $b > 1$, the function represents exponential growth b represents the growth factorIf $a > 0$ and $0 < b < 1$, the function represents exponential decay

Answer the following questions about each equation.

1. Growth or Decay?

2. What is the initial value, the y-intercept?

3. Draw a rough sketch of the following equations, then state the function's domain and range.

1. $y = \left(\frac{1}{5}\right)^x$

$$y = 1\left(\frac{1}{5}\right)^x$$

Decay

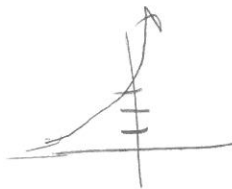
1



2. $y = 3(4)^x$

Growth

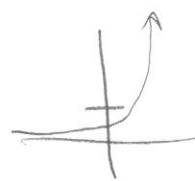
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3. $y = \frac{1}{2}(1.2)^x$

Growth

1/2



Writing equations from Word Problems.

Use the following formulas to write an exponential equation for the scenarios below.

$$y = a(1 \pm r)^t \quad \text{for exponential growth or decay}$$

$$y = Pe^{rt} \quad \text{for compounding interest continuously}$$

$$y = P\left(1 + \frac{r}{n}\right)^{nt} \quad \text{for compounding interest any other way}$$

$$\text{monthly } n=12$$

$$\text{weekly } n=52$$

$$\text{semiannually } n=2 \quad \text{quarterly } n=4$$

1. Emily plans to invest \$500 at 8.5% interest, compounded continuously. How long will it take for her money to triple?

$$\begin{aligned} y &= Pe^{rt} \\ 1500 &= 500e^{.085t} \\ 3 &= e^{.085t} \\ \ln 3 &= .085t \\ \div .085 & \quad t \approx 12.92 \text{ yrs} \end{aligned}$$

2. For Dave to buy a new car comparably equipped to the one he bought years ago would cost \$12,500. Since Dave bought the car, the inflation rate for cars like his has been at an average annual rate of 5.2%. If Dave originally paid \$8400 for the car, how long ago did he buy it?

$$\begin{aligned} 12500 &= 8400(1 + .052)^t \\ 1.488 &= 1.052^t \\ \log 1.488 &= t \log 1.052 \\ t &\approx 7.83 \text{ yrs} \end{aligned}$$

6. How long will it take Mr. Belby to double his money if he deposits \$3000 in the bank where the interest is continuously compounded at a rate of 2.5%?

$$6000 = 3000 e^{.025t}$$

$$2 = e^{.025t}$$

$$\ln 2 = .025t$$

$$\div .025$$

$$t \approx 27.73 \text{ yrs}$$

7. Ms. Ver Heecke created a sculpture out of ice that weighs 2000 pounds. If the sculpture loses 3.5% of its mass each hour, after how many hours will it be half its weight?

$$1000 = 2000(1 - .035)^t$$

$$.5 = .965^t$$

$$\log .5 = t \log .965$$

$$t \approx 19.46 \text{ hrs}$$

8. Mr. Sacco is investing some money into a bank account for his little girl's college fund. If he deposits \$15,000 when she is born (2017) at 4.7% compounded weekly, when will the account reach \$50,000?

$$50000 = 15000 \left(1 + \frac{.047}{52}\right)^{52t}$$

$$3.3333 = (1.0009)^{52t}$$

$$\log 3.3333 = 52t \log 1.0009$$

$$t \approx 25.7 \text{ yrs}$$

3. A cup of coffee contains 130 milligrams of caffeine. If caffeine is eliminated from the body at a rate of 11% per hour, how long will it take for half of this caffeine to be eliminated from a person's body?

$$65 = 130(1 - .11)^t$$

$$.5 = .89^t$$

$$\log .5 = t \log .89$$

$$t \approx 5.95 \text{ hr}$$

4. In 1910, the population of the Quad Cities was 120,000. Since then, the population has increased by exactly 1.5% per year. If the population continues to grow at this rate, what will the population be in 2020?

$$120000(1 + .015)^{110}$$

$$120000(1.015)^{110}$$

$$\approx 617,228 \text{ people}$$

5. Ms. Boehl invested \$8500 at 6%, compounded monthly.

- a. How much will she have after 5 years?

$$8500 \left(1 + \frac{.06}{12}\right)^{12(5)}$$

$$8500(1.005)^{60}$$

$$\$ 11465.23$$

- b. When will she have \$15,000?

$$15000 = 8500(1.005)^{12t}$$

$$1.765 = 1.005^{12t}$$

$$\log 1.765 = 12t \log 1.005$$

$$t \approx 9.49 \text{ yrs}$$