Unit 2 (1.9) **Applications of Logarithms Notes**

Warm-Up:

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

2. $lnx + ln5x = 11$

3. $2e^x - 1 = 7$

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

Key Concept:

$$\boldsymbol{y = a(b^x)}$$

a represents the initial value
b represents the growth factor

If $a > 0$ and $b > 1$, the function represents exponential growth
If $a > 0$ 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. $y = \left(\frac{1}{5}\right)^x$

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

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

Writing equations from Word Problems.

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

$y = a(1 \pm r)^t$	for exponential growth or decay
$y = Pe^{rt}$	for compounding interest **continuously**
$y = P\left(1 + \frac{r}{n}\right)^{nt}$	for compounding interest any other way

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

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?

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?

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?

5. Ms. Boehl invested $8500 at 6%, compounded monthly.
    a. How much will she have after 5 years?

    b. When will she have $15,000?

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%?

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?

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?