Math III
Logs and Exponents

Exponential Growth and Decay Problems

Name: _____   **Date:** _____   **Period:** _____

Formulas you need to know

Simple Interest Growth	Simple Interest Decay	Compound Interest	Continuously Compounded Interest
$A(t) = a(1 + r)^t$	$A(t) = a(1 - r)^t$	$A(t) = P\left(1 + \dfrac{r}{n}\right)^{nt}$	$A(t) = Pe^{rt}$

$A(t)$ Amount after time t.
t Time

a Initial amount
n Number of interest payments in one year

r Rate expressed as a decimal
P Initial investment

Problems you need to solve

1. Determine the balance of an account that starts with $100, has an annual rate of 4%, and the money is left in the account for 12 years.

2. In 1985, there were 285 cell phone subscribers in the small town of Centerville. The number of subscribers increased by 75% per year after 1985. How many cell phone subscribers were in Centerville in 1994?

3. Bacteria can multiply at an alarming rate when each bacteria splits into two new cells, thus doubling. If we start with only one bacteria which can double every hour, how many bacteria will we have by the end of one day?

4. Each year the local country club sponsors a tennis tournament. Play starts with 128 participants. During each round, half of the players are eliminated. How many players remain after 5 rounds?

5. The population of Winnemucca, Nevada, can be modeled by $P = 6191(1.04)t$ where t is the number of years since 1990. What was the population in 1990? By what percent did the population increase by each year?

6. You have inherited land that was purchased for $30,000 in 1960. The value of the land increased by approximately 5% per year. What is the approximate value of the land in the year 2011?

7. During normal breathing, about 12% of the air in the lungs is replaced after one breath. Write an exponential decay model for the amount of the original air left in the lungs if the initial amount of air in the lungs is 500 mL. How much of the original air is present after 240 breaths?

8. An adult takes 400 mg of ibuprofen. Each hour, the amount of ibuprofen in the person's system decreases by about 29%. How much ibuprofen is left after 6 hours?

9. You deposit $1600 in a bank account. Find the balance after 3 years for each of the following situations:

    a. The account pays 2.5% annual interest compounded monthly.

    b. The account pays 1.75% annual interest compounded quarterly.

    c. The account pays 4% annual interest compounded yearly.

10. You buy a new computer for $2100. The computer decreases by 50% annually. When will the computer have a value of $600?

11. You drink a beverage with 120 mg of caffeine. Each hour, the caffeine in your system decreases by about 12%. How long until you have 10mg of caffeine?

12. The foundation of your house has about 1,200 termites. The termites grow at a rate of about 2.4% per day. How long until the number of termites doubles?

13. If you invest $2500 in an account, what is the balance in the account and the amount of interest after 4 years if you earn:

      a. 1.7% interest compounded annually?

      b. 1.5% compounded monthly?

      c. 1.2% compounded daily?

      d. 0.7% compounded continuously?

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

      a. Write an equation you could use to determine the interest she earns in t years.

      b. How much money will Martha have in her account one year from now if she never withdraws any money and reinvests the interest?

      c. What is the effective annual rate for this account (think about what percent of her money has she earned at the end of one year)?

15. A credit card company charges 12.9% annual interest.

     a. If they compound interest monthly, how much will you owe for every dollar you do not pay off for a year?

     b. If they compound interest daily, how much will you owe for every dollar you do not pay off for a year?

     c. What is the effective annual rate in the situation above?

16. An initial investment of $700 is worth $725 a year later. What is the effective annual yield for this account?

17. A loan shark lends a gambler $1,000.00 to cover a debt. He charges 35% annual interest compounded continuously. How much does the gambler owe the loan shark at the end of one year? Two years?

18. The value of a $25,000 car depreciates at a rate of 12% per year. What will the car be worth in 5 years?