

Use this area to list the formulas needed to answer these word problems.

1. An area in North Carolina known as The Triangle is principally composed of the cities of Durham, Raleigh, and Chapel Hill. The Triangle had a population of 700,000 in 1990. The average yearly rate of growth is 5.9%. Find the projected population in 2010.

2. Determine the amount of money in a savings account that provides an annual rate of 4% compounded monthly if the initial investment is \$1000 and the money is left in the account for 5 years.

3. Using the information given in problem #2 and your graphing calculator, determine the number of years it would take for your initial investment to double.

4. How much money must be invested by Ashley if she wants to have \$20,000 in her account after 15 years? She can earn 5% compounded quarterly.

5. The population of Dubuque, Iowa, declined continuously at a rate of 0.4% between 1997 and 1998. In 1998, the population was 87,806. Suppose that the rate of decline remains steady at 0.4%. Find the project populations of Dubuque in 2010.

6. Compare the balance after 10 years of a \$5000 investment earning 8.5% interest compounded continuously to the same investment compounded quarterly.
7. Suppose a certain type of bacteria reproduces according to the model $P(t) = 27e^{t/4}$ where t is time in minutes.
- At what rate does this type of bacteria reproduce?
 - What was the initial number of bacteria?
 - Find the number of bacteria at $P(5)$, $P(15)$, $P(30)$, and $P(60)$. Round to the nearest whole number.
 - How much time will it take for the bacteria to reach a population of 1000?
8. Suppose Travis deposits \$1500 in a savings account that earns 6.75% interest compounded continuously. He plans to withdraw the money in 6 years to make a \$2500 down payment on a car. Will there be enough funds in Travis' account in 6 years to meet his goal?
9. Charlie, a developer, borrows \$150,000 at 6.5% interest, compounded quarterly, and agrees to pay off the loan in 4 years. How much interest will he owe?
10. The number of dandelions in your lawn increases by 5% a week, and there are 75 dandelions now. If $f(x)$ is the number of dandelions in week x , find the rule of the function of x . How many dandelions will there be in 16 weeks?

AA Applications of Exponential Equations Name _____

- 1) You invest \$3000 in an account that yields 6.5% interest compounded monthly.
 - a) Write a function that relates the amount of money you have after t years.
 - b) How much money will you have after 8 years?
 - c) How long will it take for your money to double?
- 2) You invest \$7500 in an account that yields 8.3% compounded annually.
 - a) Write a function that relates the amount of money you have after t years.
 - b) How much money will you have after 7 years?
 - c) How long will it take for you to have \$25,000?

- 3) A certain strain of bacteria increases according to the formula below, where $N(t)$ represents the amount present after t hours. $N(t) = 200e^{0.57t}$
 - a) What is the initial amount of bacteria?

- b) How many bacterial will there be after 2 hours?
- c) How long will it take for there to be 1000 bacteria?

- 4) The half-life of Cesium-137 is 40 years.
 - a) If 200 grams are present today, how much will be present in 5 years?
 - b) How many years will it take the 200 grams to go to 25 grams?
 - c) How many years will it take the 200 grams to do to 4 grams?

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AA Unit 3 Exponential Application

Name: _____

- 1) Bacteria grow rapidly. The population is given by the equation $N = 15e^{0.12t}$ where t is in hours. How many bacteria are present after 4 days?

- 2) The city of Dallas' population (in the 1000s) is estimated by the equation $N = 3e^{0.14t}$ where t is in years with $t = 0$ corresponding to 1960. Estimate how many people will live in Dallas in 2006?

- 3) If \$500 is invested at 17.25% compounded quarterly over 10 years, how much money will you have at the end of the 10 years?

- 4) A town has a population of 212,500 people. If the town has an annual growth rate of 2.5%, how long will it take for the town population to reach 300,000? (formula: $A = A_0 e^{kt}$)

- 5) An initial deposit of \$2100 is made into a savings account for which interest is compounded continuously. What interest rate is required to triple the balance in 8 years?

- 6) The spread of a flu virus through a certain population is modeled by $y = \frac{1000}{1 + 990e^{-0.5t}}$ where y is the total number infected after t days. In how many days will 690 people be infected with the virus?

- 7) According to the CDC Growth Chart for the United States, the median height of a girl between the ages of 2 and 20 years of age follows a logarithmic pattern represented by the model $H = 21.658 + 14.66 \ln x$. (H is measured in inches and x represents age in years.) At what age is the median height of girls in the U.S. 4.5 feet?

1. The altitude of an aircraft is in part affected by the outside air pressure and can be determined by the equation $h = (-11.1) \log\left(\frac{P}{14.7}\right)$, where h is the altitude in miles, P is the air pressure outside the aircraft.

a) Suppose the air pressure outside an airplane is 9.4, what is the altitude of the plane?

b) If a jet's altitude is 3.2 miles above sea level, what's the air pressure outside jet?

2. The model $h = 6.099 + 6.108 \ln t$ represents the average growth rates of Weeping Higan cherry trees. The variable t represents the age of the tree in years and the variable h represents the height of the tree in feet.

a. What is the average height of the trees after 12 years?

b. If a tree is measured to be 18.5 feet tall, what is its age?

3. After t years, the value of a car that costs \$32,000 is modeled by the equation

$$V = 32,000\left(\frac{4}{5}\right)^t$$

a. After how many years will the car lose half its value (put \$16,000 in for V)?

b. What will its worth be after 3 years?

4. You place \$3,500 in an account earning 7.5% interest compounded continuously.

$$B = Pe^{rt}$$

a) How much money will be in the account in 10 years?

b) How many years will it take for the account to grow to \$50,000?

5. The number of bacteria in a petri dish culture after t hours is given by the equation $B = 125e^{0.586t}$

a) What was the initial bacterial count (initial means $t = 0$)?

b) How many bacteria will be present after 18 hours?

c) How many bacteria will be present after 3 days (convert 3 days to hours)?

d) When will the number of bacteria quadruple (multiply the initial amount by 4)?

6. A total of \$15,000 is invested at an annual interest rate of 5.3%. The interest is compounded daily. Using the model $B = 15,000\left(1 + \frac{.053}{365}\right)^{365t}$, answer the following questions.

a) How much will the investment be worth in 6 years (find B)?

b) How much interest has been earned after 6 years (interest is the amount in excess of the initial investment)?

c) How long will it take for the investment to reach \$23,000?

7. How long will it take an investment to double with the following interest rates if the interest is compounded continuously?

a) 5.5%

b) 10%

c) 18%

Advanced Algebra
Applications

Name: _____

- The yield V (in millions of cubic feet per acre) for a forest at age t years is given by $V = 6.7e^{\frac{-48.1}{t}}$. Find the time necessary to have a yield of 2.1 million cubic feet.

- If \$3700 is invested at 11.5% interest compounded continuously, find the balance, B , in the account after 5 years.

- Determine the principal P that must be invested at a rate of 8% interest compounded quarterly so that the balance B in 40 years will be \$200,000.

- Determine the principal P that must be invested at a rate of 9% interest compounded monthly so that the balance B in 20 years will be \$35,000.

- Find the balance B after 15 years if \$1500 is invested in an account that pays 8.5% interest compounded quarterly.

- Find the balance B after 10 years if \$1500 is invested in an account that pays 7.5% interest compounded monthly.

- The spread of a flu virus through a certain population is modeled by $y = \frac{1000}{1 + 990e^{-0.7t}}$ where y is the total number infected after t days. In how many days will 820 people be infected with the virus?

- How long will it take an investment to double if it is compounded continuously at 6.25% interest? Show your equation and solve algebraically.

- From 1970 to 1997, the Consumer Price Index (CPI) value y for a fixed amount of sugar for the year t can be modeled by the equation $y = -171.8 + 87.1 \ln t$ where $t = 10$ represents 1970. During which year did the price of sugar reach 4.5 times its 1970 price of 28.8 on the CPI?

1) The amount y of oil collected by a petroleum company drilling on the U.S. continental shelf can be modeled by $y = 10.5 \ln x - 35.75$ where y is measured in billions of barrels and x is the number of wells drilled.

a. About how many barrels of oil would you expect to collect after drilling 500 wells?

b. About how many wells need to be drilled to collect 25 billion barrels of oil?

2. The Richter scale is used for measuring the magnitude of an earthquake. The Richter magnitude is given by: $R = 0.67 \log(0.37E) + 1.46$ where E is the energy (in kilowatt-hours) released by the earthquake.

a. An earthquake releases 15,500,000,000 kilowatt-hours of energy. What is the earthquake's magnitude?

b. How many kilowatt-hours of energy would an earthquake have to release in order to be a 8.5 on the Richter scale?

3. The wind speed s (in miles per hour) near the center of a tornado is related to the distance d (in miles) the tornado travels by the equation: $s = 93 \log(d) + 65$.

a. On March 18, 1925, a tornado whose wind speed was about 280 miles per hour struck the Midwest. How far did the tornado travel?

4. The volume of sound L (how loud a sound is) is measure in decibels. The formula to calculate how loudness of a sound is given by the formula $L = 10 \log(I / 10^{-12})$ where I is the intensity in watts per square m (W/m^2)

a) An alarm has an intensity of $5.8 \times 10^{-9} W/m^2$. How loud is the alarm in decibels?

b) Anna can scream at 56 db and Billy can yell at 48 db. How many more times intense is Anna's scream than Billy's yell?