8-1 Exponential Growth and Decay Applications

> **Take the following steps to solve each word problem.**
> 1. Read the problem to determine whether it represents growth, decay, or compound interest.
> 2. Write down the correct formula and reread the problem.
> 3. Substitute the given values into the formula.
> 4. Solve the equation for the variable.
> 5. Write your answer in a complete sentence.

1. Your grandparents gave you $2000 the day you were born. Your parents put this gift into a savings account that pays 4.5% interest compounded quarterly. Today is your 16th birthday and you go to the bank to withdraw your money to purchase your first car. The car you want cost $5,526. Do you have enough money? If not how much more do you need?

$$A = P\left(1 + \frac{r}{n}\right)^{nt}$$

$$2000\left(1 + \frac{.045}{4}\right)^{(4 \cdot 16)} = \$4092.38$$

$$
\begin{array}{r}
5526.00 \\
-4092.38 \\
\hline
\$1433.62 \text{ short}
\end{array}
$$

NO → $1433.62 short

2. In 1990, the annual out of state tuition at Florida State University was $2,200. During the next 10 years, tuition increased by 6.2% each year. $y = a(1+r)^n$

a. Write an exponential growth model for the cost of tuition. $y = 2,200(1+.062)^x$

$y = 2200(1.062)^x$

b. What is the "growth factor?" 1.062

c. Graph the model using the TI83-84. What is the y-intercept??? $(0, 2200)$

d. What does x represent? $time (yrs)$ What does y represent? the cost of tuition

e. What is a good window for this function? Make a "sketch" to the right.

Xmin: -5 Xmax: 30 Xscl: 1 Ymin: -10 Ymax: 10000

f. Estimate the year when the tuition was $3,500. 1998 $x = 8$

$(0, 2200)$

$x = 0$ at 1990

g. What was the tuition in 2005? $\$5423.63$ $x = 15$ What was the tuition in 2010? $\$7326.78$ $x = 20$

h. What will the tuition be the year YOU are ready to enter college?
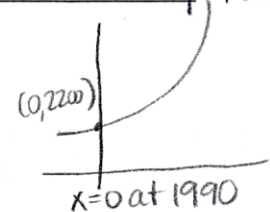
Current Status	Year you enter College	Tuition
Freshmen	2017 $x=27$	$11,163.10
Sophomores	2016 $x=26$	$10,511.39
Juniors	2015 $x=25$	$9897.73
Seniors	2014 $x=24$	$9319.90

3. Radioactive Decay: Ten grams of Carbon 14 is stored in a container. The amount C (in grams) of Carbon 14 present after t years can be modeled by $C = 10(0.99987)^t$. How much Carbon 14 is present after 1000 years?

$$C = 10(0.99987)^{1000}$$

$8.78 grams$

4. Erik bought a new computer for \$3,200. The value of the computer will decrease by about 50% annually.

   a. Write an exponential decay model for the value of the computer. $y=a(1-r)^t$ $y=3200(1-.5)^x$

       $y=3200(.5)^x$

   b. What is the "decay factor?" 0.5

   c. Using the model, estimate the value of your computer after 2 years. $\$800$

   d. Graph the model using the TI-83 or 84 and the appropriate window. What is the y-intercept? $(0, 3200)$

   e. What is a good window for this function? Make a "sketch" to the right.

       Xmin: -5 Xmax: 30 Xscl: 1 Ymin: -5 Ymax: 4000

   f. When will the computer will be worth \$600? in 2.5 yrs. When will it be less than \$100? after 5 years.

5. The number of newly reported cases of tuberculosis (in thousands) in the United States from 1991 to 1996 can be approximated by the equation $T = 28.5(0.9567)^t$, where t represents the number of years since 1990.

   a. What is the initial amount? $28,500$ the decay factor? $.9567$ the annual % decrease? $.0433 = 4.33\%$

   b. When was the number of newly reported cases approximately 25,000? $x=3$ 1993 $1-r=.9567$

   c. Graph the model using the TI-83 or 84 and the appropriate window. What is the y-intercept? $(0, 28.5)$

                                                                                                                                $28,500$

   d. In what year were there 16,000 newly reported cases? 2003 ($x=13$)

   e. Estimate the number of newly reported cases in 2005. $14.672 = 14,672$ ($x=15$)

6. If \$700 is deposited into an account that pays 4.3% interest compounded monthly, what would the balance in the account be after 7 years? (p. 488, #20)

   $$A = P\left(1+\frac{r}{n}\right)^{nt}$$
   $$A = 700\left(1+\frac{.043}{12}\right)^{(12\cdot7)} \qquad \boxed{\$945.34}$$

7. Determine how much is in a retirement account after 20 years if \$5000 was invested at 6.05% interest compounded weekly. (p. 488, #21)

   $$A = 5000\left(1+\frac{.0605}{52}\right)^{(52\cdot20)} \qquad \boxed{\$16,755.63}$$

8. A college savings account pays 13.2% annual interest compounded semi-annually. What is the balance of an account after 12 years if \$21,000 was initially deposited? (p. 488, #23)

   $$A = 21,000\left(1+\frac{.132}{2}\right)^{(2\cdot12)} \qquad \boxed{\$97,362.61}$$