Growth, Decay, and Compound Interest Formulas

Growth Formula:

y is the final amount. t is time.

$$y = a(1 + r)^t$$

$1 + r = b$

a is the initial amount. r is the rate of growth expressed as a decimal, $r > 0$.

Decay Formula:

y is the final amount. t is time.

$$y = a(1 - r)^t$$

$1 - r = b$

a is the initial amount. r is the rate of decay expressed as a decimal, $0 < r < 1$.

Compound Interest Formula:

Interest rate (decimal)

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

Time (years)

Amount   Principal   Number of times interest is compounded per year

Growth and Decay Problems

Growth

1. The population of the United States has been increasing at an average annual rate of 0.91%. If the population of the United States was about 284,905,400 in the year 2001, predict the U.S. population in 2020.

0.91%
$\downarrow$
0.0091

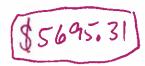$$y = a(1+r)^t \longrightarrow y = 284,905,400(1+.0091)^{19}$$
$$y = 338,415,774.2$$

2. A new car that sells for $18,000 depreciates 25% each year.

   a. Write a function that models the value of the car.

   $$y = 18,000(1-0.25)^t$$

   b. What is the value of the car after 4 years?

   $$y = 18000(0.75)^4$$

   $$\$5695.31$$

3. In 2010, the tuition at a private college was $30,000. During the next 9 years, tuition increased by about 7.2% each year.

   $7.2\% \rightarrow .072$

   a. Write a model giving the cost C of tuition at the college t years after 2010.

   $$y = 30,000(1+.072)^t$$

   b. What is the tuition in 2030?

   $2010 \rightarrow 2030 = 20 \text{ years}$

   $$y = \$120,508.30$$

   c. What year was the tuition about $35,000?

   $$35000 = 30000(1+0.072)^t$$

   $$2012$$

4. A diamond ring was purchased twenty years ago for $500. The value of the ring increased by 8% each year.

   8%
   $\downarrow$
   0.08

   a. What is the value of the ring today?

   $$y = 500(1+.08)^{20}$$

   $$y = \$2330.48$$

   b. What is the value of the ring in 10 years?

   $$\$5031.33$$

Growth and Decay Problems

5. Maria <u>invests</u> $5500 into a college savings account that pays 3.25% quarterly. How much money will there be in the account after 5 years?

$$A = P\left(1 + \frac{r}{n}\right)^{nt} \longrightarrow A = 5500\left(1 + \frac{.0325}{4}\right)^{20}$$

compound

$$\boxed{A = \$6466.22}$$

6. A new car costs $32,000. It is expected to depreciate 12% each year for 4 years and then depreciate 8% each year thereafter. Find the value of the car in 6 years.

$$y = a(1-r)^t \Rightarrow y = 32000(1 - 0.12)^4 = \$19,190.25$$

$$y = 19190.25(1 - 0.08)^2$$

$$\boxed{y = 16,242.63}$$

7. You invest $100,000 in an account with 1.01% interest, compounded quarterly. Assume you don't touch the money or add money other than the earned interest.

   a. Write an equation that gives the amount of money, y, in the account after x years.

$$A = 100,000\left(1 + \frac{.0101}{4}\right)^{4x}$$

   b. How much money will you have in the account after 10 years?

$$A = \$110,613.58$$

   c. How much money will you have in the account after 25 years?

$$A = \$128,682.99$$

Compounded Monthly: 12

Weekly: 52

Daily: 365

Annually: 1

Semi-annually:

bi-annually: