

Exponential Growth and Decay Word Problems

1. Find a bank account balance if the account starts with \$100, has an annual rate of 4%, and the money 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. 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.
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. Rupert will be buying a new car for \$15,000 in three years. How much money should he ask his parents for now so that, if he invests it at 5% compounded continuously, he will have enough to buy a new car?

8. How many years will it take for an initial investment of \$10,000 to grow to \$25,000? Assume a rate of interest of 6% compounded continuously?

9. The population of a colony of mosquitoes obeys the law of continuous growth. If there are 1000 mosquitoes initially, and there are 1800 after one day, what is the growth rate? What is the size of the colony after 3 days? How long is it till there are 1000 mosquitoes?

10. The half-life of Radium is 1690 years. If ten grams are present now, how much will be present in 50 years?

11. A piece of charcoal is found to contain 30% of the carbon-14 it originally had. When did the tree from which the charcoal came from die? Use 5600 years as the half-life of carbon-14.

12. After the release of radioactive material into the atmosphere in Ukraine in 1986, the hay in Austria was contaminated by iodine-131 (half life 8 years). If it is okay to feed the hay to cows when 10% of the iodine-131 remains, how long do the farmers need to wait to use this hay?

Exponential Growth and Decay Word Problems

Key

1. Find a bank account balance if the account starts with \$100, has an annual rate of 4%, and the money left in the account for 12 years.

$$100(1 + .04)^{12} = \boxed{\$160.10}$$

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?

$$285(1 + .75)^9 = \boxed{43,871 \text{ subscribers}}$$

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?

L1	0	1	2	3	4	5	6	7
L2	1	2	4	8	16	32	64	128

$y = 2^x$ ← doubling instead of 12

$$2^{24} = \boxed{16,777,216}$$

4. 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.

$$1600 \left(1 + \frac{.025}{12}\right)^{12 \cdot 3} = \boxed{\$1724.48}$$

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

$$1600 \left(1 + \frac{.0175}{4}\right)^{4 \cdot 3} = \boxed{\$1686.05}$$

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

$$1600(1 + .04)^3 = \boxed{\$1799.78}$$

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?

6191

.04 → 4%

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?

$$30,000(1 + .05)^{51} = \boxed{\$361,223.09}$$

51 years later

7. Rupert will be buying a new car for \$15,000 in three years. How much money should he ask his parents for now so that, if he invests it at 5% compounded continuously, he will have enough to buy a new car?

$$15,000 = Pe^{-.05(3)}$$

$$15,000 = 1.16P$$

$$P \approx \boxed{\$12,910.62}$$

8. How many years will it take for an initial investment of \$10,000 to grow to \$25,000? Assume a rate of interest of 6% compounded continuously?

$$\frac{25,000}{10,000} = \frac{10,000}{10,000} e^{.06t}$$

$$2.5 = e^{.06t}$$

$$\ln 2.5 = .06t$$

$$.916 = .06t$$

$$t = \boxed{15.3}$$

9. The population of a colony of mosquitoes obeys the law of continuous growth. If there are 1000 mosquitoes initially, and there are 1800 after one day, what is the growth rate? What is the size of the colony after 3 days? ~~How long is it till there are 1000 mosquitoes?~~

④

$$\textcircled{I} \frac{1800}{1000} = \frac{1000e^{1 \cdot r}}{1000}$$

$$1.8 = e^r$$

$$r = \ln 1.8 = \boxed{.588}$$

⑤

$$\textcircled{II} 1000e^{.588(3)}$$

$$\boxed{5835.7}$$

10. The half-life of Radium is 1690 years. If ten grams are present now, how much will be present in 50 years?

①

$$5 = 10e^{1690r}$$

$$\frac{1}{2} = e^{1690r}$$

$$\ln \frac{1}{2} = 1690r$$

$$-.693 = 1690r \rightarrow r = -4.100E-4 \rightarrow -.00041$$

②

$$10e^{50(-.00041)} = \boxed{9.8}$$

11. A piece of charcoal is found to contain 30% of the carbon-14 it originally had. When did the tree from which the charcoal came from die? Use 5600 years as the half-life of carbon-14.

SKIP!

12. After the release of radioactive material into the atmosphere in Ukraine in 1986, the hay in Austria was contaminated by iodine-131 (half life 8 years). If it is okay to feed the hay to cows when 10% of the iodine-131 remains, how long do the farmers need to wait to use this hay?

①

$$50 = 100e^{8r}$$

$$\frac{1}{2} = e^{8r}$$

$$\ln \frac{1}{2} = 8r$$

$$-.693 = 8r$$

$$r = -.086625$$

$$10 = 100e^{(-.086625)t}$$

$$.1 = e^{(-.086625)t}$$

$$\ln .1 = -.086625t$$

$$-2.3025 = -.086625t$$

$$\frac{-2.3025}{-.0866} = \frac{-.086625t}{-.0866}$$

$$t = \boxed{26.6}$$

doesn't
say amount
50 can
make up