

# Homework 3.5: Applications of Exponentials

Name: Key!

Math 3

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.

$$y = 100(1.04)^{12}$$

$$y = \$160.10$$

$\$160.10$

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. In what year were there 6,209 cell phone subscribers?

$$6209 = 285(1.75)^t$$

$$21.8 = (1.75)^t$$

$$\log 21.8 = t \log 1.75$$

$$t = \frac{\log 21.8}{\log 1.75}$$

$$t = 5.5 \text{ years}$$

1990

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?

$$y = 1(2)^{24}$$

$$y = 16,777,216$$

16,777,216  
bacteria

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?

$$y = 128(0.5)^5$$

$$y = 4$$

4 players

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?

\*population in 1990 was 6191 people.

\*Growth rate was 4% per year.

$$1.04 - 1 = 0.04$$

$$0.04 \times 100 = 4\%$$

6. You have inherited land that was purchased for \$30,000 in 1960. If the value of the land was \$90,000 in 1975, by what rate did the value increase by each year?

$$90000 = 30000(1+r)^{15}$$

$$3 = (1+r)^{15}$$

$$\sqrt[15]{3} = 1+r$$

$$1.076 = 1+r$$

$$0.076 = r$$

7.6%

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?

$$y = 500 (1 - 0.12)^{\text{Breaths}}$$

$$y = 500 (0.88)^{240}$$

$$y = 0.000000000002 \text{ mL}$$

Basically no air is left in the lungs.

8. An adult takes 400 mg of ibuprofen. Each hour, the amount of ibuprofen in the person's system decreases by about 29%. How many hours did it take for 51.24 mg of ibuprofen to remain in the person's system?

$$51.24 = 400 (1 - 0.29)^t$$

$$t = \frac{\log 0.1281}{\log 0.71}$$

$$0.1281 = (0.71)^t$$

$$\log 0.71$$

6 hours

$$\log 0.1281 = t \log 0.71$$

$$t = 6$$

9. You deposit \$1600 in a bank account. Find the rate of growth if \$37,400 is in the account after 20 years.

$$37400 = 1600 (1+r)^{20}$$

$$1.171 = 1+r$$

$$23.375 = (1+r)^{20}$$

$$0.171 = r$$

17.1%

$$\sqrt[20]{23.375} = 1+r$$

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

$$600 = 2100 (1 - 0.50)^t$$

$$t = \frac{\log 0.2857}{\log 0.5}$$

$$0.2857 = (0.5)^t$$

$$\log 0.5$$

1.81 years

$$\log (0.2857) = t \log (0.5)$$

$$t = 1.81$$

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?

$$10 = 120 (1 - 0.12)^t$$

$$t = \frac{\log 1/12}{\log .88}$$

$$1/12 = (0.88)^t$$

$$\log .88$$

19.44 years

$$\log 1/12 = t \log 0.88$$

$$t = 19.44$$

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?

$$2400 = 1200 (1 + 0.024)^t$$

$$t = \frac{\log 2}{\log 1.024}$$

$$2 = (1.024)^t$$

$$\log 1.024$$

29.23 days

$$\log 2 = t \log 1.024$$

$$t = 29.23$$

13. The half-life of Cs-137 is 30.2 years. If the initial mass of the sample is 1.00kg, how much will remain after 151 years?

$$y = 1 (0.5)^{151/30.2}$$

$$y = 0.03125$$

0.03125 kg