Math I

take out HW

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. → multiplicative rate growth rate/factor

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

$y = 100(1+.04)^{12}$

$\boxed{\$160.10}$

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?

$285(1.75)^9$ $\boxed{43871.99}$

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?

$1(2^{24})$ $\boxed{16,777,216}$

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?

$128(.5)^5$ $\boxed{4}$

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?

at 1990, population was 6191

Population increased by 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?

$30,000(1.05)^{51}$ $\boxed{\$361,223.09}$

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?

$500(.88)^{240}$

$500(1-.12)^{240}$

2.37×10^{-11}

1. The bacteria *E. coli* often cause illness among people who eat the infected food. Suppose a single *E. coli* bacterium in a batch of ground beef begins doubling every 10 minutes.

   a. Fill in the table below for the number of bacteria *y* at each 10 minute interval *x*

x	0	1	2	3	4	5	6 (1 hour)
y	1	2	4	8	16	32	64

   b. Write a rule or equation for the number of bacteria *y* at each stage of growth *x*

   $y = 1(2^x)$

   c. Use your rule to determine the number of bacteria after 2 hours. → 12 stages

   $y = 4096$

2. Penicillin was discovered by observing mold on biology lab dishes. When first observed, the mold covered 7 cm^2 of the dish surface. It then appeared to triple in area every day.

   a. Fill in the table below for the area of the mold patch *y* for every day *x*

x	0	1	2	3	4	5	6	7 (one week)
y	7	21	63	189	567	1701	5103	15309

   b. Write a rule or equation for the area of the mold patch *y* at each stage of growth *x*

   $y = 7(3^x)$

   c. When will the area of the mold be greater than 150,000 cm^2?

   $150{,}000 = 7(3^x)$ $\boxed{x = 10}$

   d. Use your rule to determine the area of mold after 2 weeks. 14 stage

   $y = 7(3^{14}) = \boxed{33{,}480{,}783}$

   e. What if the area started at 4 cm^2, how would your equation change?

   the 4 would replace the initial value, 7, in the equation

3. In 2000, the number of people worldwide living with HIV/AIDS was estimated to be 36 million. That number was growing at an annual rate of 3%.

   a. Write an exponential growth equation that you could use to determine the number of people living with HIV/AIDS at any given year after 2000.

   $y = 36(1.03)^x$ $1 + .03 = 1.03$

   b. Use the equation to determine the number of people with HIV/AIDS after 10 years.

   $36(1.03)^{10}$ $\boxed{48.4 \text{ million}}$

   c. How many people would be affected by the year 2014? → 14 years

   $36(1.03)^{14}$ $\boxed{54.5 \text{ million}}$

4. Suppose the acreage of forest is decreasing by 2% each year because of new development. If there are currently 4,500,000 acres of forest, determine the amount of forest land after each of the following yea[rs]. In the equation, *t* is the number of years after 2014. $y = 4{,}500{,}000(.98)^x$

   a. 2015 $t = 1$ $\boxed{4{,}410{,}000}$

   b. 2017 $t = 3$ $\boxed{4{,}235{,}364}$

   c. 2022 $t = 8$ $\boxed{3{,}828{,}433.6}$

   d. 2032 $t = 18$ $\boxed{3{,}128{,}104}$

   $1 - .02 = .98$

5. You invest $100 dollars in a high-risk mutual fund at 12% interest compounded annually. How much money will you have in your account at the end of 15 years?

   $100(1.12)^{15}$ $\boxed{\$547.36}$

   $(1 + .12)$

The exponential population growth of an ant colony can be modeled by the function, $A = 2(1.15)^t$ when t is the number of weeks.

a. According to the model, what is starting number of ants?

2

b. What is the rate of growth? %

15%

multiplicative rate: = 1.15

c. Use the model to determine the number of ants after one year. 52 weeks

$2(1.15)^{52}$ $\boxed{2866}$

Use your calculator to model the exponential regression shown in each table.

7.

x	0	1	2	3	4	10
y	100	90	81	72.9	65.61	34.87

$\frac{10}{100} = .1$ ↓

Equation: $y =$

$\frac{90}{100} = .90$ multiplier

$y = 100(.90^x)$

$(1 - .10)$

What is the initial (starting) amount?

100

What is the rate of decay (as a percent)?

10%

What is the value of y, when x is 10?

34.87

8.

x	0	1	2	3	4	10
y	400	420	441	463.05	486.2025	684.14

÷1.05 ÷1.05 $\frac{21}{420}$ .05 ↑ ×1.05

Equation: $y =$

$y = 400(1.05)^x$

$1 + .05$

What is the initial (starting) amount?

400

What is the rate of growth (as a percent)?

5%

What is the value of y, when x is 10?

684.14