Warm Up

Any questions about yesterday's packet?

Homework Questions?

Name Key Period Date

Exponential Decay – Practice Problems

1. Garden City introduced a recycling program. The goal of the program is to reduce the number of pounds of trash sent to landfills by 25% each year. In 2010, Garden City produced 100,000 tons of trash. If the recycling program were to reach its goal, how many tons of trash can Garden City expect to produce in the year 2025?

$y = 100{,}000(0.75)^x$

$y = 100{,}000(0.75)^{15}$

$y = 1336.3$ tons

2025 − 2010 = 15 yrs

How to find the Factor:

25% decrease means 75% remaining each year. Factor = 0.75

OR

Factor = 1 + Rate
= 1 − 0.25
= 0.75

−0.25 because decreasing by 25%

2. A city of 2,950,000 has a 2.5% annual decrease in population. Determine the city's population after each of the following:

$y = 2{,}950{,}000(0.975)^x$

a. 1 year $y = 2{,}950{,}000(0.975)^1 = 2{,}876{,}250$ people

b. 5 years $y = 2{,}950{,}000(0.975)^5 = 2{,}599{,}232$ people

c. 15 years $y = 2{,}950{,}000(0.975)^{15} = 2{,}017{,}861$ people

d. 25 years $y = 2{,}950{,}000(0.975)^{25} = 1{,}566{,}525$ people

3. Several species of whale have been declared endangered. When the populations of a particular whale species fall dangerously low, biologists encourage governments to agree to a ban on hunting the species. Suppose that, in the year 2000, there were only 5,000 whales of a particular species and that the population was predicted to continue to decline as shown in the table.

Year (y)	Whales (w)
0 (2000)	5,000
1	4,500
2	4,050
3	3,645
4	3,281
5	2,952
6	2,657

×0.90 ×0.90 ×0.90 ×0.90 ×0.90 ×0.90

Factor

a. Which equation below models this population pattern?

A. $W = 5{,}000(0.1^y)$

B. $W = 5{,}000(0.9^y)$

C. $W = 5{,}000 - 500^y$

D. $W = 5{,}000^y$

b. What is the decay factor for the relationship? Explain how you determined your answer.

The decay factor is 0.9. I found this by "dividing up the table," dividing one number by the previous number in the table.

c. Define all the numbers and variables in the equation in the context of the problem.

The number of whales "y" years after 2000.

$$W = 5{,}000(0.9^y)$$

Each year 90% of the population remains.

Number of years since 2000.

There were 5000 whales in year 2000.

d. According to this model, what will the whale population be in 2007?

$W = 5{,}000(0.9)^7$

$W = 2391$ whales

e. What is the decay rate?

Factor = 1 + Rate

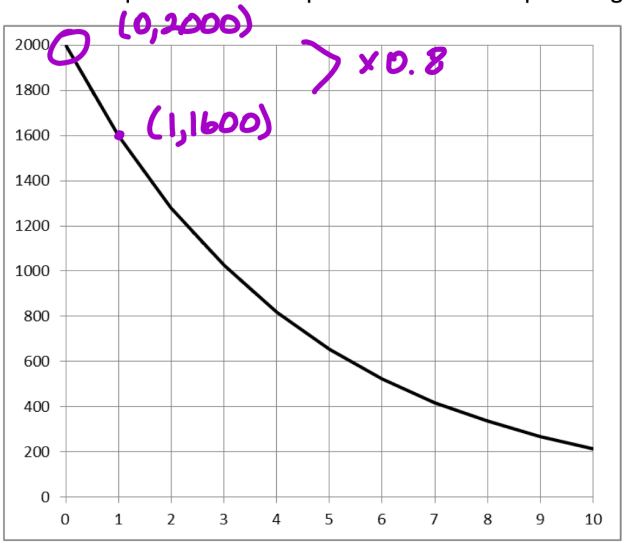
0.9 = 1 + Rate

−1 −1

−0.1 = Rate

10% decrease

4. Write an equation for the exponential relationship in the graph below. Show your work.



$y = 2000(0.8)^x$

5. The population of a certain species of bird is decreasing by 10% each year. If the population in year 0 is 15,000, which of the following statements are true? *Select all that apply.*

- ☐ In year 7, there will be fewer than 7,000 of this species of bird.
- ☑ After 5 years, there will be approximately 8,857 of this species of bird.
- ☑ The graph of this relationship shows exponential decay.
- ☐ The decay factor is 0.10.
- ☑ After 1 year, there will be 13,500 of this species of bird.

1 yr. $y = 15{,}000(0.9)^1 = 13{,}500$

5 yrs. $y = 15{,}000(0.9)^5 = 8857$

7 yrs. $y = 15{,}000(0.9)^7 = 7174$

6. In some areas, home values have decreased over the past 10 years. The table shows the decrease in the home value of one house.

Year	Home Value	
0	$250,000	×0.97
1	$242,500	×0.97
2	$235,225	×0.97
3	$228,168	×0.97
4	$221,323	×0.97
5	$214,684	

Using the tiles, write an equation that represents the value of the home, v, after t years.

1.03	0.03	250,000
0.97	1.30	t

$v =$ (250,000)(0.97)$^{(t)}$

7. A tree farm has begun to harvest a section of trees that was planted a number of years ago. The table shows the number of trees remaining for each of 8 years of harvesting.

Year	0	1	2	3	4	5	6	7	8
Trees remaining	10,000	9502	9026	8574	8145	7737	7350	6892	6543

0.95 0.95 0.95 0.95 0.95 0.95 0.95 0.95

a. Suppose the relationship between the year and the number of trees remaining is exponential. Approximate the decay factor for this relationship. Explain how you found this.

The decay factor is 0.95. I found this by "dividing up the table," dividing one number by the previous number in the table.

b. Write an equation for the relationship between time and trees remaining.

$y = 10{,}000(0.95)^x$

c. Use your equation to find how many trees will be left after 20 years?

$y = 10{,}000(0.95)^{20} = 3584$ trees remaining

9. Another tree farm plans to harvest their trees so that there was a linear relationship with the initial data presented in the table below.

Year	0	1
Trees remaining	10,000	9502

+1

-498

$\frac{\Delta y}{\Delta x} = -\frac{498}{1}$

b. Write an equation for the relationship between time and trees remaining.

$y = -498x + 10{,}000$

c. Use your equation to find how many trees will be left after 20 years?

$y = -498(20) + 10{,}000$
$= 40$ trees remaining

Classwork

Name: _____ Period: ____

6.4 EXPONENTIAL GROWTH WORKSHEET

In the growth models shown for #1–8, identify the initial amount, growth factor, and percent growth rate.

1. $y = 2(1.25)^t$

Initial Amount: _____

Growth Factor: _____

Growth Rate: _____

2. $y = 3(1.05)^t$

Initial Amount: _____

Growth Factor: _____

Growth Rate: _____

3. $y = 0.1(1.75)^t$

Initial Amount: _____

Growth Factor: _____

Growth Rate: _____

4. $y = 7(1.04)^t$

Initial Amount: _____

Growth Factor: _____

Growth Rate: _____

5. $y = (1.0068)^t$

Initial Amount: _____

Growth Factor: _____

Growth Rate: _____

6. $y = 14.8(2)t$ $y = 14.8(2)^t$

Initial Amount: _____

Growth Factor: _____

Growth Rate: _____

7. $y = 5{,}403(3.1)^t$

Initial Amount: _____

Growth Factor: _____

Growth Rate: _____

8. $y = 9(1.002)^t$

Initial Amount: _____

Growth Factor: _____

Growth Rate: _____

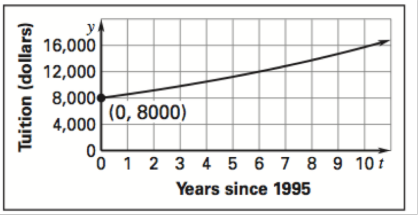
9. **A successful small business made $10,000 in profit in the year 2000. Then the profit began to increase by 8% each year. If this trend continues…**

a. Write an exponential growth function that models the profit in dollars over time.

b. What will the profit be in 2015?

c. What will the profit be in 2025?

10. **From 1995 to 2005, the tuition at a college increased by about 7% per year. If this trend continues…**



a. Write an exponential growth function that models the tuition over time.

b. What will the tuition be in 2020?

c. What was the tuition in 1995?

d. What was the tuition in 2011?

11. **The table shows the total numbers of shares of initial public offering A purchased days after it opens on the stock market.**

a. What is the initial amount?

b. What is the growth factor?

c. What is the growth rate?

d. Write an exponential growth function that models the number of shares over time.

Public Offering A

days	*number of shares*
0	400
1	600
2	900
3	1350
4	2025

12. **The table shows the total numbers of shares of initial public offering B purchased days after it opens on the stock market.**

a. What is the initial amount?

b. What is the growth factor?

c. What is the growth rate?

d. Write an exponential growth function that models the number of shares over time.

Public Offering B

days	*number of shares*
0	625
1	750
2	900
3	1080
4	1296

13. **Use the information from questions 11–12 to answer the following:**

a. On which day did the two public offerings have the same number of shares sold?

b. On day 15, *how many more* shares will public offering A have sold than public offering B?

(Worked–Out Solutions Online!)

ANSWERS:

1. initial amt: 2
   growth factor: 1.25
   growth rate: 25%

2. initial amt: 3
   growth factor: 1.05
   growth rate: 5%

3. initial amt: 0.1
   growth factor: 1.75
   growth rate: 75%

4. initial amt: 7
   growth factor: 1.04
   growth rate: 4%

5. initial amt: 1
   growth factor: 1.0068
   growth rate: 0.68%

6. initial amt: 14.8
   growth factor: 2
   growth rate: 100%

7. initial amt: 5,403
   growth factor: 3.1
   growth rate: 210%

8. initial amt: 9
   growth factor: 1.002
   growth rate: 0.2%

9. a. $y = 10{,}000(1.08)^t$
   b. $31,721.69
   c. $68,484.75

10. a. $y = 8{,}000(1.07)^t$
    b. $43,419.46
    c. $8,000.00
    d. $23,617.31

11. initial amt: 400 shares
    growth factor: 1.5
    growth rate: 50%
    $y = 400(1.5)^t$

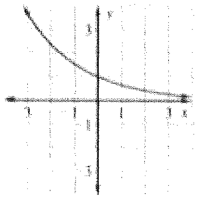
12. initial amt: 625 shares
    growth factor: 1.2
    growth rate: 20%
    $y = 625(1.2)^t$

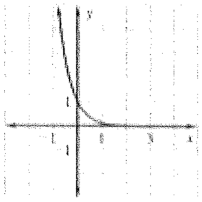
13. a. Day 2 (they both sold 900 shares on day 2) b. A will have sold 165,529 more shares than B on day 15.

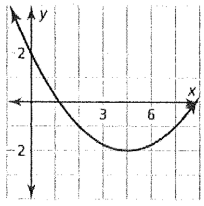
Name: _____ Period: ____

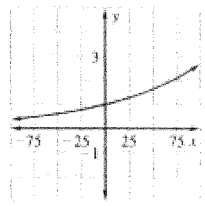
6.4 Exponential DECAY Worksheet

State whether the graph shows exponential growth, exponential decay or neither.

1. 

2. 

3. 

4. 

State whether the equation shows exponential growth or exponential decay. Explain how you know.

5. $y = 3.4(^1/_5)^x$

6. $y = (1.234)^x$

7. $y = 5(0.47)^x$

8. $y = 0.11(^8/_3)^x$

For the decay models shown, identify the initial amount, decay factor, and *percent* decay rate.

9. $y = 6(0.98)^t$

Initial Amount: _____

Decay Factor: _____

Decay Rate: _____

10. $y = 7.4(0.23)^t$

Initial Amount: _____

Decay Factor: _____

Decay Rate: _____

11. $y = (0.2)^t$

Initial Amount: _____

Decay Factor: _____

Decay Rate: _____

12. $y = 4(0.003)^t$

Initial Amount: _____

Decay Factor: _____

Decay Rate: _____

13. $y = (0.999)^t$

Initial Amount: _____

Decay Factor: _____

Decay Rate: _____

14. $y = 13(^1/_2)t$

Initial Amount: _____

Decay Factor: _____

Decay Rate: _____

15. $y = {}^2/_3(0.702)^t$

Initial Amount: _____

Decay Factor: _____

Decay Rate: _____

16. $y = 9(0.0501)^t$

Initial Amount: _____

Decay Factor: _____

Decay Rate: _____

17. **You buy a used car for $12,000. It depreciates at a rate of 15% per year. If this trend continues...**

a. Write an exponential decay function that models the profit in dollars over time.

b. What is the value of the car after 1 year?

c. What is the value of the car after 5 years?

18. **Business A had 4000 employees in 2001. Each year the number of employees has decreased by 2.1%.**

a. Write an exponential decay function that models the employment of Business **A** over time.

b. How many employees will Business A have in 2017?

19. **The table shows declining employment for Business B over time where t is number of years since 2005.**

t	0	1	2	3
Employees	7000	6300	5670	5103

a. What is the initial amount?

b. What is the decay factor?

c. What is the decay rate?

d. Write an exponential decay function that models the employment of Business **B** over time.

20. **Use the information from questions 18–19 to answer the following:**

a. Which business will have more employees in 2017?

b. How many more employees will that business have than the other in 2017?

(Worked–Out Solutions Online!)

ANSWERS:

1. Decay
2. Decay
3. Neither
4. Growth
5. Decay
6. Growth
7. Decay
8. Growth
9. initial amt: 6
   decay factor: 0.98
   decay rate: 2%
10. initial amt: 7.4
    decay factor: 0.23
    decay rate: 77%
11. initial amt: 1
    decay factor: 0.2
    decay rate: 80%
12. initial amt: 4
    decay factor: 0.003
    decay rate: 99.7%
13. initial amt: 1
    decay factor: 0.999
    decay rate: 0.1%
14. initial amt: 13
    decay factor: ½ or 0.5
    decay rate: 50%
15. initial amt: $^2/_3$
    decay factor: 0.702
    decay rate: 29.8%
16. initial amt: 9
    decay factor: 0.050
    decay rate: 94.99%
17. a. $y = 12{,}000(0.85)^t$
    b. $10,200
    c. $5,324.46
18. a. $y = 4{,}000(0.979)^t$
    b. 2,848 employees
19. initial amt: 7,000 employees
    decay factor: 0.9
    decay rate: 10%
    $y = 7{,}000(0.9)^t$
20. a. Business A will have more employees in 2017
    b. 871 more employees

Homework

Finish classwork