10.1. Advanced Algebra

DATE: 12/3

Solving Exponential Growth/Decay Problems

Target 4B. Model and evaluate applications involving exponential growth and decay

Growth:

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

Decay:

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

a = initial **amount** before measuring growth/decay

r = growth/decay **rate** (often a percent)

x = number of **time** intervals that have passed

1) Given the equation $y = 225(1.23)^x$

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b) What is the rate of growth or decay?
c) What is the initial value?
d) Evaluate for $x = 2$

1) a) Growth because $1.23 > 1$
b) $.23 = 23\%$
c) 225
d) $y = 225(1.23)^2 \approx 340.40$ (to 2 decimal places) nearest hundredth

2) Given the equation $y = 154(1.06)^x$
a) Does this equation represent growth or decay?
b) What is the rate of growth or decay?
c) What is the initial value?

2) a) Growth
b) $.06 = 6\%$
c) 154

3) Given the equation $y = 35(0.57)^x$
a) Does this equation represent growth or decay?
b) What is the rate of growth or decay?
c) What is the initial value?
d) Evaluate for $x = 3$

3) a) Decay because $0.57 < 1$
b) $1 - 0.57 = 0.43 = 43\%$
c) 35
d) $y = 35(0.57)^3 \approx 6.48$

For each word problem, write the exponential equation to model the situation. Then, solve the problem.

4) A zombie infection at Morton East High School grows (Growth) by 15% per hour. The initial group of zombies was a group of 4 sophomores. How many zombies are there after 6 hours?

$a = 4$
$r = 15\% = 0.15$
$x = 6$

$y = 4(1+0.15)^6 \approx 9$ ≈ 9 zombies

ALWAYS WRITE RATE AS A DECIMAL

5) Ryan is saving for his college tuition. He has $2,550 in a savings account that pays 6.25% annual interest. How much money does he have at the end of two years?

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$a = 2,550$

$r = 6.25\% = 0.0625$

$x = 2$

$y = 2550(1 + 0.0625)^2 \approx \$2,878.71$ $\approx \$2878.71$

decay

6) Cars depreciate in value over time. A used car was purchased for $12,329 this year. Each year the car's value decreases 8.5%. How much is the car worth after five years?

$a = 12,329$

$r = 8.5 = 0.085$

$x = 5$

$y = 12,329(1 - 0.085)^5 = \$7,907.39$ $\approx \$7907.39$

7) Jeremiah owns a side business detailing cars. His first year he made $10,500 and each of the following years his profit increased 9%. How much money did he make in three years? Growth

$a = 10500$

$r = 9\% = 0.09$

$x = 3$

$y = 10,500(1 + 0.09)^3 = \$13,597$ $\approx \$13,597$

8) There are 128 teams entered in a basketball tournament. Half of the teams are eliminated each round. How many teams are left after 4 rounds?

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decay

$a = 128$

$r = 50\% = 0.50$

$y = 128(1 - 0.50)^4 = 8$

8 games left

$x = 4$

9) Bacteria in a dirty glass triple every hour. If there are 25 bacteria to start, what is the bacteria count after 1 day?

Growth

$a = 25$

$b = 3/\text{hour}$

$x = 24$ (1 day)

$y = 25(3)^{24} \approx 7{,}060{,}738{,}412{,}000$ trillion!

10) The population of a city of 750,000 people is devastated by an unknown virus that kills 20% of the population per day. How many people are left after a week?

Decay

$a = 750{,}000$

$r = 20\% = 0.20/\text{day}$

$x = 7$ (1 week)

$y = 750{,}000(1 - 0.20)^7 \approx 157286$

$\approx 157{,}286$ people left

11) There are 1,750,235 acres of forest in northwestern Idaho. One-half percent of the forest is destroyed by pollution every year. How many acres are left after 65 years?

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Decay

$a = 1{,}750{,}235$

$r = 0.5\% = 0.005$

$x = 65$

$y = 1{,}750{,}235(1 - 0.005)^{65} \approx$

you finish!

12) A new Ipod is estimated to lose 25% of its value every six months after purchase. How much is the value of an Ipod that costs $299 after someone has owned it for 2 years?

Decay

$a = 299$

$r = 25\% = 0.25$ / 6 months

$x = 4$ (2 yrs = 4 time intervals)

$y = 299(1 - 0.25)^{4} \approx$

you finish!

13) A recent college graduate accepts a job at Google Inc. The job has a salary of $47,000 and is guaranteed an annual pay increase of 3%. What is the person's salary at the beginning of their 10th year of work?

growth

$a = 47{,}000$

$r = 3\% = 0.03$

$x = 10$

$y = 47{,}000(1 + 0.03)^{10} \approx$

You finish!