EXPONENTIAL review FUNCTIONS

$$f(x) = a \cdot b^x$$

initial value "start" — common factor "multiply by"

EXPONENT RULES

Exponents are a shortcut for repeated MULTIPLICATION:

$a^3 = a \cdot a \cdot a$

$a^n \cdot a^m = a^{n+m}$ $\quad a^0 = 1$

$\frac{a^n}{a^m} = a^{n-m}$ $\quad (a^n)^m = a^{n \cdot m}$

$a^{-m} = \frac{1}{a^m}$ & $\frac{1}{a^{-m}} = a^m$

CAREFUL: $(x+3)^2 = (x+3)(x+3)$

DO NOT DISTRIBUTE EXPONENTS

GROWTH

INcreasing

$b > 1$

ex: $5 \cdot (1.05)^x$

DECAY

DEcreasing

$0 < b < 1$

ex: $5 \cdot (0.95)^x$

BUT: Humans like *percentages* %

$1.05 = (1 + 0.05)$ APprecite by 5%

$0.95 = (1 - 0.05)$ DEpreciate by 5%

DECODING

WORD PROBLEMS

A car costs $20,000 in 2018. Its value appreciates by 7.2% each year.

Write a function

$a = 20{,}000$

$b = (1 + 0.072)$

$= 1.072$

$f(x) = 20{,}000 \cdot (1.072)^x$

Interpret a function

PERCENT ⇨ DECIMAL

$8.3\% = \frac{8.3}{100} = 0.083$

(divide by 100 & remove % symbol)

DECIMAL ⇨ PERCENT

$0.73 = \frac{0.73 \cdot 100}{1 \cdot 100} = 73\%$

(multiply by 100 & add % symbol)

TABLES

x	f(x)
-1	4
0	2
1	1
2	½

+1, +1, +1

$\frac{2}{4} = \frac{1}{2}$, $\frac{1}{2} = \frac{1}{2}$, $\frac{1/2}{1} = \frac{1}{2}$

$f(x) = 2 \cdot (\frac{1}{2})^x$

x	f(x)
0	2
2	3.38

$\times 2^2$

① $f(x) = 2 \cdot b^x$

② $f(2) = 2 \cdot b^2$

③ $3.38 = 2b^2$

④ $\frac{3.38}{2} = \frac{2b^2}{2}$

⑤ $1.69 = b^2$

⑥ $\sqrt{1.69} = \sqrt{b^2}$

⑦ $1.3 = b$

$f(x) = 2 \cdot (1.3)^x$

Exponential Functions Word Problems

1. Every time Pinocchio lies, his nose grows about 20% of its size. Originally his nose is 2 inches long. Write an equation that models this situation. 20% $y = 2(1.20)^x$

- How long will his nose be after he tells 20 lies? 77in
- How many lies would he have to tell before his nose is longer than 3 feet? 36in

16 lies

2. Scrooge invests $500. He found a bank that would pay him 4% interest. If he deposits the whole $500 and does not deposit or withdraw any other amount, how much money would he have after 4 years?

$500(1.04)^4$ $585

3. Jiminy Cricket is 3 feet away from his house when it starts to rain. As more rain falls, Jiminy can't jump as far. On his first jump, he is half the distance to his house. With each jump, he only makes it half the distance of his previous jump. Write an equation to model this situation. $3(.5)^x = y$

- How far will he be from his house after 10 jumps? $3(.5)^{10} = .0029$ ft

Will he ever make it home? Why or why not?

4. Which is more: being given one million dollars, or one penny the first day, double that penny the second day, then double the previous day's amount and so on for a month? Show your work.

$.01(2)^{31} = 21,474,836$ 31

penny deal

5. Due to a severe drought, a population of lions is decreasing at a rate of 3.5% per year. Scientists have noticed 80 lions in the area. After how many years will this population drop to below 15 lions if this rate continues? $80(.965)^x$

100 − 3.5 = 96.5%

47 yrs

How many lions will be left after 4 years? $80(.965)^4$

6. As of 2018, the world population is 7.616 billion people and is growing at a rate of 1.1% per year. Write an equation to represent this information. What is the predicted population for 2050?

.011

2050 − 2018

$7,616,000,000(1.011)^{32}$ 1.08×10^{10}

7. Since January 1980, the population of Arondale has grown according to the mathematical model $y = 720,000(1.022)^x$, where x is the number of years since January 1980. What do the numbers 720,000 and 1.022 represent?

start

growth

2.2%

What would the population of Arondale be today if the growth continues at the same rate?

Complete Exponential Function and Exponents Plus WS

Name: Key

Exponential Functions and Exponents Plus

1. Rodney purchases a car for $17,400. The value of the car depreciates by 12% per year. What is the value of the car after 8 years? $17400(.88)^8 \approx \$6,258$

2. Simplify: $\left(\frac{2x^{-3}y^2}{m^{-5}n^4}\right)^2 (x^3m^3)$ $\left(\frac{2^2x^{-6}y^4}{m^{-10}n^8}\right)(x^3m^3) = \frac{4y^4m^{13}}{x^3n^8}$

3. Which of the following is **not true** regarding the function $y = 2^x$:
a. The function is an exponential function
b. The function has a domain of all real numbers
c. As the value of x gets very large the value of y gets close to zero
d. As the value of x increases by one the value double

4. If a student deposits $1500 in the bank and earns an annual interest rate of 8% how much will he have after 15 years? $1500(1.08)^{15} = \$4758$

5. Which of the following is true for $y = .5(3)^x$
a. The function shows exponential growth.
b. The function shows exponential decay.
c. The function is a linear function.
d. The y intercept is 3.

6. The population of Barnardsville in 2014 was estimated to be 24,000 people with an annual rate of increase (growth) of about 2.4%. Which function would give you the estimated total population, y, of Barnardsville in 2021? 2021 - 2014 = 7

[A] $y = 24000\ (1 + 2.4)^7$ [C] $y = 24000\ (1 + .024)^7$

[B] $y = 24000\ (1 + 2.4)^{21}$ [D] $y = 24000\ (1 + .24)^{21}$

7. Simplify: $\left(\frac{x^5y^5}{y^3}\right)^2$ $\frac{x^{10}y^{10}}{y^6} = x^{10}y^4$

8. Gavin wants to spend less than half (1000) of his monthly $2,000 paycheck on housing and savings. also wants to spend at most 30% (600) of his paycheck on housing and at least 10% (200) of his paycheck savings. Which system of inequalities can be used to determine the amount Gavin can spend housing, *h*, and savings, *s*?

a. ~~$h + x < 1000$~~
~~$h < 600$~~
$s > 200$

b. $h + s < 1000$
$h \leq 600$
$s \geq 200$

c. $h + s < 1000$
~~$h < 600$~~
$s > 200$

d. ~~$h + s < 2000$~~
$h \leq 600$
$s \geq 200$

Name:_____

9. Fernando bought a new car at a cost of $28,000. The car depreciates approximately 15% of its value each year. Which function would give you the estimated value of the car, y, after t years?

[A] $y = 28000\ (.15)^t$ [B] $y = 28000\ (1.150^t$ [C] $y = 28000\ (.85)^t$ [D] $y = 28000\ (1.015)^t$

10. Sydney plans to put her graduation money into an account and leave it there for 4 years while she goes to college. She receives $900 in graduation money that she puts into an account earning 4.25% interest annually. How much will be in Sydney's account at the end of four years?

[A] $1,052.87 [B] $1,063.03 [C] $3,711.09 [D] $293,628.5 $900(1.0425)^4$
1063.03

11. Maria recorded the population for two different cities in North Carolina. The results are shown in

11. Maria recorded the population for two different cities in North Carolina. The results are shown in the table below

Time (years)	City 1, NC	City 2, NC
2008	950	150
2010	1,248	299
2012	1,551	598
2014	1,862	1196

Which statement best describes her data?

[A] Both cities' population changed at a constant rate.

[B] Both cities' population changed at an exponential rate.

[C] City 1 increased its population at a constant rate, and City 2 increased its population at an exponential rate.

[D] City 1 increased its population at an exponential rate, and City 2 increased its population .

12. The standard form of a quadratic equation is $y = ax^2 + bx + c$. Write the formula in terms of a.

$a = \frac{y - bx - c}{x^2}$

13. Solve for p: $\left(2p - 1 - \frac{7(3p+3)}{2} = \frac{2p-5}{14}\right)14$

$28p - 14 - 21p - 21 = 2p - 5$

$7p - 35 = 2p - 5$

$-2p + 35 = -2p + 35$

$5p = 30$

$p = 6$

14. What is the equation of the line that is parallel to -4x + 3y = 5 and passes through (7.5, 4)?

$4 = \frac{4}{3}(7.5) + b$

$4 = 10 + b$

$-10 \quad -10$

$-6 = b$

$y = \frac{4}{3}x - \frac{5}{4}$

$y = \frac{4}{3}x - 6$

15. What is the equation of the line that is perpendicular to 10x + 5y = 8 and passes through (6, 17)?

$\frac{5y}{5} = \frac{-10x}{5} + \frac{8}{5}$

$m = \frac{1}{2}$