Algebra 2 CC Name ________________________________

More Exponential Models Review 2020

1.) Researchers in a local area found the population of rabbits with an initial population of 20, grew **continuously** at the rate of 5% per month. The fox population had an initial value of 30, and grew **continuously** at the rate of 3% per month.

Find, the nearest tenth of a month, how long it takes for these populations to be equal.

Rabbits

$y = 20e^{.05x}$

Foxes

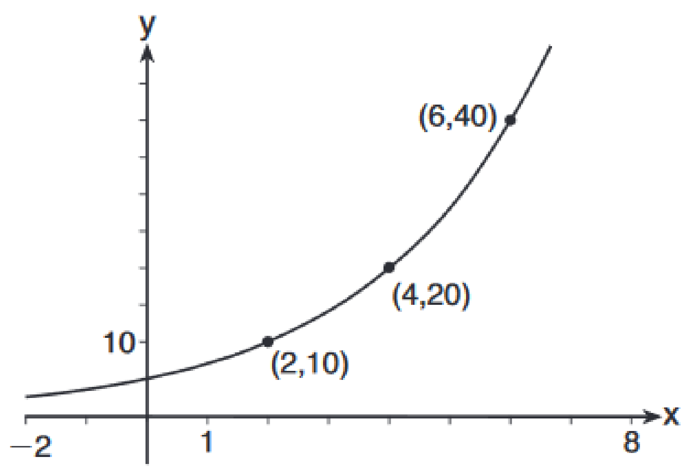
$y = 30e^{.03x}$

Intersection

$(20.3, 55.1)$

$\boxed{20.3 \text{ months}}$

2.) The graph of $y = f(x)$ is shown below.



Which expression defines $f(x)$?

(A) $2x$ (B) $5(2^x)$ (C) $5\left(2^{\frac{x}{2}}\right)$ (D) $5(2^{2x})$

3.) The data collected by a biologist showing the growth of a colony of bacteria at the end of each hour are displayed in the table below.

Time, hour, (x)	0	1	2	3	4	5
Population (y)	250	330	580	800	1650	3000

Write an **exponential regression** equation, rounding to the ***nearest thousandth***.

$$y = 215.983(1.652)^x$$

4.) A certain type of bacteria will **double** every 10 **days**.

a. If you start with 16 cells of bacteria, write a function that will give the number of bacteria, N, after d days.

$$\boxed{N = 16(2)^{\frac{d}{10}}}$$

b. Using the equation from part (a), to determine the number of bacteria cells after 31 days. [Round to the whole number]

$$N = 16(2)^{\frac{31}{10}}$$

$$\boxed{N = 137}$$

5.) A payday loan company makes loans between $100 and $1000 available to customers.

Every 14 days, customers are charged 30% interest with compounding.

In 2013, Remi took out a $300 payday loan.

Which expression can be used to calculate the amount she would owe, in dollars, after one year if she did not make payments?

(A) $300(0.30)^{\frac{14}{365}}$ (B) $300(1.30)^{\frac{14}{365}}$ (C) $300(0.30)^{\frac{365}{14}}$ (D) $300(1.30)^{\frac{365}{14}}$

6.) Iodine – 131 is a radioactive isotope used in the treatment of thyroid conditions. Iodine – 131 will naturally get removed from the body after an extended period of time. For most patients, **half** of the radioactive isotope will leave the body after 4 days. A recent patient just received 20 grams of Iodine – 131. Let I represent the amount of Iodine – 131, in grams, over d days.

a. Write an equation that will model this situation.

$$I = 20\left(\frac{1}{2}\right)^{\frac{d}{4}}$$

b. What is the rate of decay **per day**? Round to the *nearest tenth*.

$$I = 20\left(\frac{1}{2}^{\frac{1}{4}}\right)^{d}$$

$$I = 20(.841)^{d}$$

$1 - r = .841$

$r = .159$

$\boxed{15.9\ \%}$

7.) Jamie is going to buy a home for \$155,000. The formula to compute a mortgage payment, M,

$$M = P \bullet \frac{r(1+r)^N}{(1+r)^N - 1}$$ where P is the principal amount of the loan, r is the monthly interest rate,

and N is the number of monthly payments. Jamie's bank offers a monthly interest rate of 0.25% for a 20-year mortgage.

$20 \cdot 12 = 240$ months

With no down payment, determine Jamie's mortgage payment, rounded to the **nearest dollar**.

$$M = 155{,}000 \bullet \frac{.0025(1.0025)^{240}}{(1.0025)^{240} - 1}$$

$$M = 155{,}000(.0055\ldots)$$

$$\boxed{M = \$860}$$

b. Algebraically determine and state the down payment, ***rounded to the nearest dollar***, that Jamie needs to make, in order for her mortgage payment to be \$800.

$$800 = P(.0055\ldots)$$

$$P = 144{,}249$$

$$\begin{array}{r} 155{,}000 \\ -144{,}249 \\ \hline \boxed{\$10{,}751} \end{array}$$

8.) Last year, the total revenue (R) for Taco Hut, a national restaurant chain, increased 4% over the previous **year** (y). They used the model: $R = (1.04)^y$.

If this trend were to continue, which expression could the company's chief financial officer use to approximate their **monthly** percent increase in revenue? [Let $\boldsymbol{m}$ represent months.]

(A) $R = (1.04)^m$ (B) $R = (1.04)^{12m}$ (C) $R = (1.00327)^m$ (D) $R = (1.00327)^{\frac{m}{12}}$

$$R = (1.04)^{\frac{m}{12}}$$

$$R = \left(1.04^{\frac{1}{12}}\right)^m$$

$$R = (1.00327)^m$$

9.) A student studying bacteria find the population of a specific strand of bacteria increased 30% in an hour. She used the model: $B = 20(1.30)^t$, where B is the population of bacteria and t is the time in hours. Another student, Jamie, wants to use a model that would predict the population of bacteria after $\boldsymbol{m}$ minutes.

(A) $B = 20(1.03)^m$ (B) $B = 20(1.0044)^m$

(C) $B = 20(1.003)^m$ (D) $B = 20(1.18)^m$

$$B = 20(1.30)^{\frac{m}{60}}$$

$$B = 20\left(1.30^{\frac{1}{60}}\right)^m$$

$$B = 20(1.0044)^m$$

10.) Using a microscope, a researcher observed and recorded the number of bacteria spores on a large sample of uniformly sized pieces of meat kept at room temperature. A summary of the data she recorded is shown in the table below.

Hours (x)	**Average Number of Spores** (y)
0	4
0.5	10
1	15
2	60
3	260
4	1130
6	16,380

Write an exponential regression equation, rounding all values to the ***nearest thousandth***.

$$y = 4.168(3.981)^x$$

11.) You have \$1200 in a savings account. The money in the savings account will **double** every 8 years.

Let P represent the principal amount of money in the savings account over t years.

a. Write an equation that will model this scenario.

$$P = 1200(2)^{\frac{t}{8}}$$

b. How much money, ***to the nearest cent***, will be in the savings account after 20 years?

$$P = 1200(2)^{\frac{20}{8}}$$

$$\boxed{P = \$6788.23}$$

12.) Monthly mortgage payments can be found using the formula: $M = \dfrac{P\left(\frac{r}{12}\right)\left(1+\frac{r}{12}\right)^n}{\left(1+\frac{r}{12}\right)^n - 1}$

M = monthly payment , P = amount borrowed
r = annual interest rate , n = number of **monthly** payments

$5 \cdot 12 = 180$ months

You would like to borrow $160,000 to purchase a home.
They qualify for an annual interest rate of 4.5%. What is the monthly payment over a **15-year** period?
[Round to the nearest cent]

$$M = \frac{160{,}000\left(\frac{.045}{12}\right)\left(1+\frac{.045}{12}\right)}{\left(1+\frac{.045}{12}\right)^{180} - 1}$$

$$\boxed{M = \$1223.99}$$

13.) Titanium-44 is a radioactive isotope that will decreases in mass by **one-half** every 63 years.

a. If you start with an initial mass of 100 grams of Titanium-44, write a function that will give the mass, M, remaining after t years.

$$M = 100\left(\frac{1}{2}\right)^{\frac{t}{63}}$$

b. Using the equation from part (a), how much of the sample of Titanium-44 is remaining after 45 years.

[Round to the nearest tenth.]

$$M = 100\left(\frac{1}{2}\right)^{\frac{45}{63}}$$

$$\boxed{M = 61.0}$$

$5 \cdot 12 = 60$ months

14.) Using the formula below, determine the monthly payment on a 5-year car loan with a monthly percentage rate of 0.6% for a car with an original cost of \$24,000 and a \$3000 down payment, ***to the nearest cent***.

$$P_n = PMT\left(\frac{1-(1+i)^{-n}}{i}\right)$$

$$\begin{array}{r} 24,000 \\ -\ 3,000 \\ \hline 21,000 \end{array}$$

P_n = present amount borrowed

n = number of monthly pay periods

PMT = monthly payment

i = interest rate per month

$$21,000 = PMT\left(\frac{1-(1+.006)^{-60}}{.006}\right)$$

$$21,000 = PMT\,(50.26\ldots)$$

$$\boxed{PMT = \$417.81}$$

b. An affordable monthly payment for your budget is \$350, over the same time period. Determine an appropriate down payment, ***to the nearest dollar***.

$$P_n = 350\,(50.26\ldots)$$

$$P_n = 17,592$$

$$\begin{array}{r} 24,000 \\ -17,592 \\ \hline \boxed{\$6408} \end{array}$$