

TEST NAME: **Exponentials BANK 1**
TEST ID: **47627**
GRADE: **09**
SUBJECT: **Mathematics**
TEST CATEGORY: **My Classroom (Individual Teacher Assessments)**

Student: _____

Class: _____

Date: _____

1. A state conservation agency reports that there are currently 3000 deer in a forest. The agency also reports that the deer population is increasing by 10% each year. Which of the following functions models the deer population after n years?

- A. $P(n) = 3000 (0.1)^n$
- B. $P(n) = 3000 (1.1)^n$
- C. $P(n) = 3000 + 0.1n$
- D. $P(n) = 3000 + (1.1)^n$

2. The finance manager for Devine Designs is trying to predict the net profits of the company for each of the next four years. She does not know exactly what the net profits will be each year, so she left them as variables.

Year	Net Profits
1	a
2	b
3	c
4	d

She assumes that the net profits will grow at an exponential rate during this time span. For her assumption to be correct, which of the following equations must be *true*?

- A. $b + a = c + b = d + c$
- B. $b - a = c - b = d - c$
- C. $b \cdot a = c \cdot b = d \cdot c$
- D. $\frac{b}{a} = \frac{c}{b} = \frac{d}{c}$

3. The number of bacteria in a colony can be modeled by the exponential function $N = 4 \cdot 2^{0.25t}$, where t is the time, in hours.

Part A:

Write an expression for t involving logarithms that can be used to determine when the number of bacteria in the colony is expected to be 4800, and explain how you determined your answer.

Part B:

Evaluate the expression from Part A to the nearest tenth.

4. Suppose the change in value (depreciation) of a car is the following formula:

$u = n(1 - 0.936)^{\frac{1}{t}}$, where u is the used price of the car, n is the amount that the car cost new, and t is the age of the car in years.

What is the used value of a 3 year–old–car that cost \$15,000 new?

- A. \$327
- B. \$320
- C. \$6000
- D. \$11,183.21

5. Frank suspects a function he created to predict the population of bacteria is flawed.

His data indicates the population began with 150 cells and grew by 20 percent every hour.

His prediction function is "The population of bacteria is $B(h) = 150(.2)^h$ after h hours."

What is Frank's error?

- A. Frank should have used (.20) not (.2) in the equation.
- B. Frank should have used (1.2) not (.2) in the equation.
- C. Frank should have used a power of $h - 1$ instead of h .
- D. Frank should have used a power of $h + 1$ instead of h .

6. Joe wants to determine if he should buy Boat A or Boat B, and if he should wait 3 years to buy the boat or if the value of the boat will have increased.

The value of the Boat A is represented by the function $V_A(t) = 24,000(.85)^t$, and the value of Boat B is represented by the function $V_B(t) = 22,000(.90)^t$.

Which of the following statements explains what Joe should do and why?

- A. He should wait and buy Boat A because the value of Boat A will decrease at a larger constant rate per year.
- B. He should wait and buy Boat A because the value of Boat A will decrease by a larger constant percent rate per year.
- C. He should buy Boat B now because the value of the boats will increase by a constant rate per year.
- D. He should buy Boat B now because the value of the boats will increase by a constant percent rate per year.

7. A table of points is shown below.

n	a_n
2	180
4	1620
7	-43,740

Which of these equations correctly models the points in the table?

- A. $a_n = 180 \cdot (-9)^{n-1}$
- B. $a_n = 60 \cdot (3)^{n-1}$
- C. $a_n = 180 \cdot (9)^{n-1}$
- D. $a_n = -60 \cdot (-3)^{n-1}$

8. The table below shows the number of students enrolled at Hawthorne High School over a 5-year period. The equation $y = 821(1.1)^x$ describes the curve of best fit for the number of students enrolled each year (y). Let x represent the number of years since 1998.

Students Attending Hawthorne HS	
Year	Students
1998	821
1999	903
2000	995
2001	1,090
2002	1,201

Using this equation, what would be the approximate number of students who are enrolled in the school in the year 2006?

- A. 1,322
B. 1,454
C. 1,760
D. 1,936
9. Which situation can be modeled by a linear function with a constant rate of change?
- A. The number of deer in an area increases by 3% per year.
B. The area of a square increases with the side length of the square.
C. The number of pages remaining in a book decreases by 48 pages every hour.
D. The value of a bank account each year is 1.025 times the value of the previous year.
10. The table below shows the number of runners registered for the local Valentine's Day 5K Run over a 4-year period. The equation $y = 85(1.3)^x$ describes the curve of best fit for the number of registered runners each year (y). Let x represent the number of years since 1999.

Valentine's Day 5K Race	
Year	Runners
1999	85
2000	111
2001	144
2002	186

Using this equation, what would be the approximate number of runners who register for the 5K race in the year 2006?

- A. 243
B. 410
C. 533
D. 595

11. Which of the following situations can be modeled by a linear function, where one quantity changes at a constant rate relative to another? Select *three* that apply.
- A. The number of bacteria in a Petri dish starts at 100 bacteria and doubles every hour.
 - B. The amount of water in a tub starts at 60 gallons and drains at rate of 10 gallons per minute.
 - C. The amount of flour in a jar starts at 10 cups and decreases by $\frac{3}{4}$ of a cup per batch of cookies made.
 - D. The number of people waiting in line at a theater starts at 15 and increases by 10 people every 5 minutes.

12. Jane earns \$8.00 for every hour she works at the bookstore, which is represented by the equation $y = 8x$.

She uses this equation to prove that for every additional three hours she works she earns an additional \$24. Her work is shown below.

Time Interval

If $x_1 = a$ and $x_2 = a + 3$

Then $x_2 - x_1 = 3$

Additional Money Earned

If $x_1 = a$, then $y_1 = 8a$

If $x_2 = a + 3$, then $y_2 = 8(a + 3)$

$y_2 - y_1 = 8(a + 3) - 8(a)$

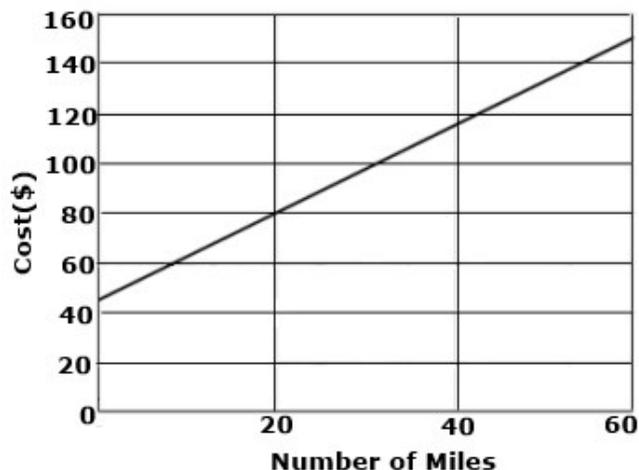
$= 8a + 24 - 8a$

$= 24$

Does Jane's work prove that for every additional 3 hours she works she earns an additional \$24?

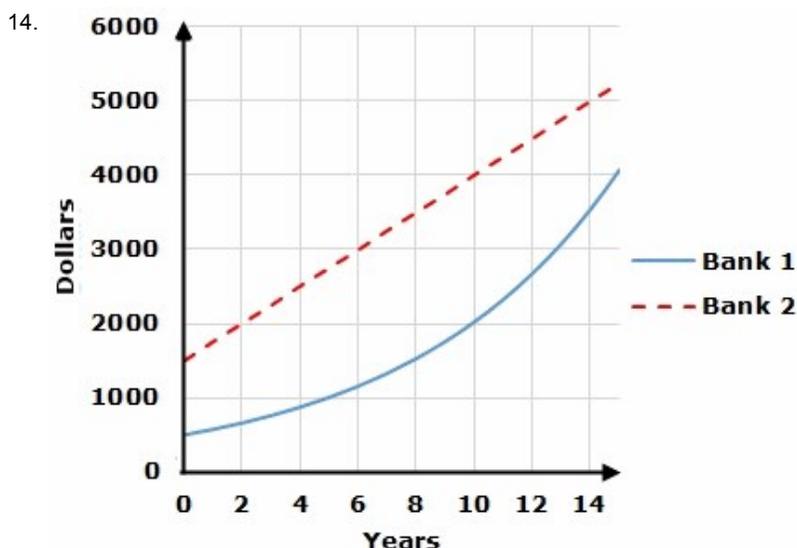
- A. Yes, because the difference between y_2 and y_1 will be 24 for any value of a .
- B. Yes, because the difference between y_2 and y_1 will be 24 no matter what her hourly rate is.
- C. No, because the difference between y_2 and y_1 changes when the value of a changes.
- D. No, because the difference between y_2 and y_1 changes when her hourly rate changes.

13. Billy is renting a vehicle for a few days. Billy has to pay a flat rate plus a rate per mile, as shown in the graph below.



The cost of Billy's vehicle rental, $R(m)$, can be represented by which of the following functions?

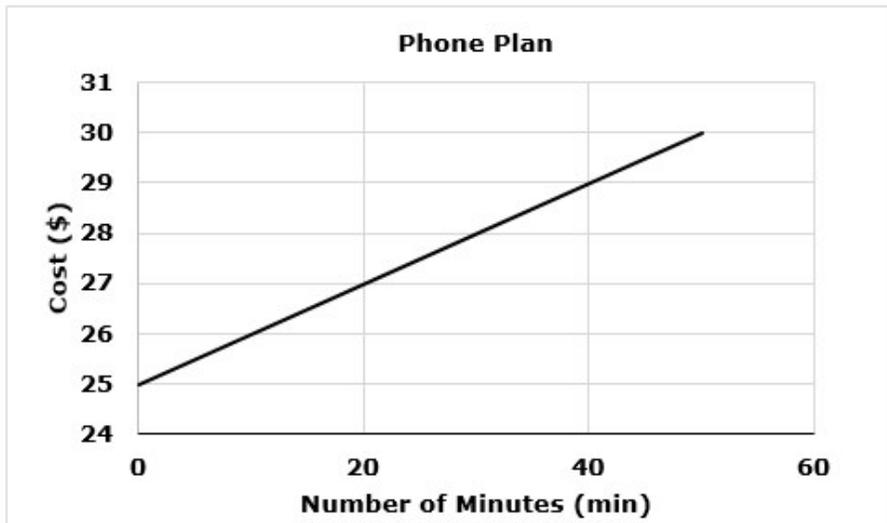
- A. $R(m) = 45(1.75 - 1)^m$
- B. $R(m) = 45(1.75)^m$
- C. $R(m) = -1.75m + 45$
- D. $R(m) = 1.75m + 45$



Tyler and Daniel have each deposited money into different banks with different savings plans. Tyler went to Bank 1 and deposited \$500. Daniel went to Bank 2 and deposited \$1500. The graph above shows how much money is in each savings account after 14 years. According to the graph, who will have more money by year 20?

- A. Daniel, because his money is increasing linearly.
- B. Daniel, because his money is increasing exponentially.
- C. Tyler, because his money is increasing linearly.
- D. Tyler, because his money is increasing exponentially.

15.



Sarah pays a flat rate plus a rate per minute for her phone plan as shown in the graph above.

The cost of Sarah's phone plan, $C(t)$, can be represented by which of the following functions?

- A. $C(t) = -0.10t + 25$
- B. $C(t) = 0.10t + 25$
- C. $C(t) = 25(0.10)^t$
- D. $C(t) = 25(1 + 0.10)^t$

16. Two-thousand ounces of a radioactive substance are stored in a radioactive container. This substance can be modeled by the equation $y = 2000e^{-0.00043t}$, where y is the amount of the substance left after t years.

Approximately how many years will it take until only 50 ounces of this substance remain?

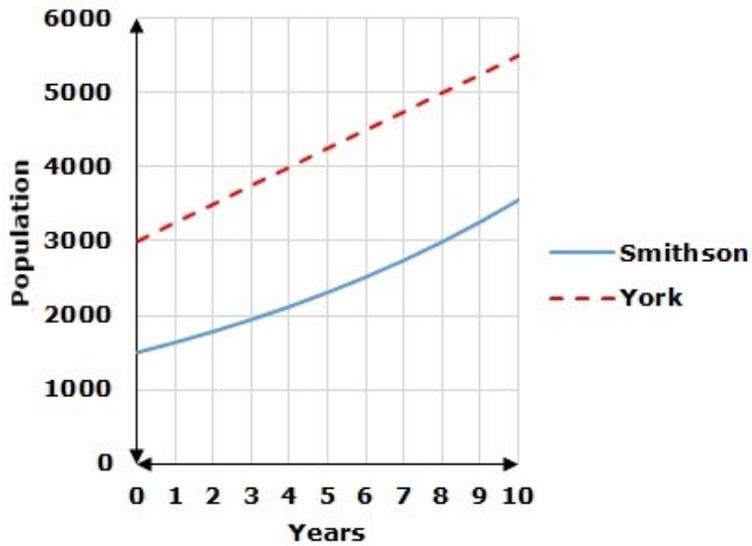
- A. 58 years
- B. 1196 years
- C. 3725 years
- D. 8579 years

17. As time, t , passes, the value of an investment is modeled by the function:
 $V(t) = 50(0.9)^t$

Which of the following statements is supported by the behavior of $V(t)$?

- A. The value of the investment will decrease over time.
- B. The value of the investment will increase over time.
- C. The value of the investment will remain the same.
- D. No generalizations can be made because the value of the investment will both increase and decrease over time.

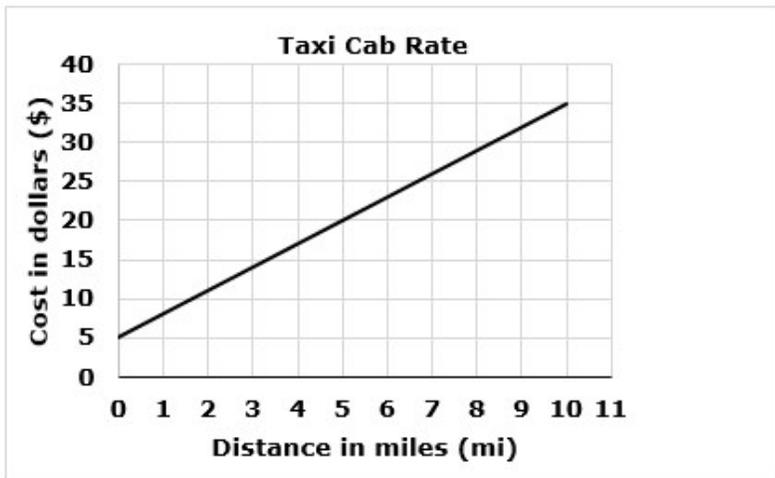
18.



The town of Smithson and the town of York each were established at the same time. The graph above shows the growth rates between the two towns. If both towns continue to grow in population at the same rate, which town would have the larger population at year 30?

- A. Smithson will have the larger population because it is increasing linearly.
- B. Smithson will have the larger population because it is increasing exponentially.
- C. York will have the larger population because it is increasing linearly.
- D. York will have the larger population because it is increasing exponentially.

19.



A taxi cab charges an initial flat rate of \$5 plus an additional \$3 for every mile traveled, as shown by the graph above.

Michael wants to prove that the cost increases by \$15 for every additional 5 miles traveled. His work is shown below.

Additional Distance Traveled

If $x_1 = a$ and $x_2 = a + 5$, then $x_2 - x_1 = 5$

Additional Cost

If $x_1 = a$, then $y_1 = 3a + 5$

If $x_2 = a + 5$, then $y_2 = 3(a + 5) + 5$

$y_2 - y_1 = 3(a + 5) + 5 - (3a + 5)$

$= 3a + 15 + 5 - 3a - 5$

$= 15$

From Michael's work which of the following relationships are shown to be true? Select *two* that apply.

- A. The additional cost of \$15 depends on the value of a .
- B. The additional cost of \$15 depends on the slope of the line.
- C. The additional cost of \$15 depends on the value of the y -intercept.
- D. The additional cost of \$15 depends on the difference between x_2 and x_1 .

20. For their wedding, Rajai and Carly received \$1000. Their financial advisor laid out 4 different options for them to invest in. Assuming that each option continues to grow according to the pattern shown below, what would be their best investment for when they retire in 40 years?

A.	Year	0	1	2	3
	Amount	\$1000	\$1075	\$1150	\$1225
B.	Year	0	1	2	3
	Amount	\$1000	\$1001	\$1004	\$1009
C.	Year	0	1	2	3
	Amount	\$1000	\$1200	\$1300	\$1350
D.	Year	0	1	2	3
	Amount	\$1000	\$1050	\$1103	\$1158

21. The y -values of four different functions are shown in the table below.

x -value	0	1	2	3
Function 1	1500	1706	1912	2118
Function 2	5000	5050.5	5101	5151.5
Function 3	2000	2400	2880	3456
Function 4	100	150	225	337.5

If the functions continue to follow the same patterns shown in the table, select *all* of the functions that will have a y -value greater than 10,000 when $x = 25$.

- A. Function 1
- B. Function 2
- C. Function 3
- D. Function 4

22. Matt sets up a stand to sell pretzels. He sells each pretzel for \$3.00. The amount of money he earns selling pretzels is represented by the function $y = 3n$, where y represents the money he earns in dollars and n represents the number of pretzels he sells.

He uses this equation to show that for every 5 additional pretzels he sells he earns an additional \$15. His work is shown below.

Number of Pretzels:

If $n_1 = a$ and $n_2 = a + 5$, then $n_2 - n_1 = 5$.

Additional Money Earned:

If $n_1 = a$, then $y_1 = 3a$.

If $n_2 = a + 5$, then $y_2 = 3(a + 5)$

$y_2 - y_1 = 3(a + 5) - 3(a)$

$= 3a + 15 - 3a$

$= 15$.

Which of the following conclusions can be made about the additional money Matt will earn for every 5 additional pretzels he sells? Select *two* that apply.

- A. He will always earn an additional \$15 because $y_2 - y_1$ is not dependent on a .
- B. The additional money he will earn depends on the initial number of pretzels he has sold because $y_2 - y_1$ is dependent on a .
- C. The additional money he will earn is not a constant amount because the function increases by different amounts for every 5 additional pretzels sold.
- D. The additional money he will earn is a constant amount because the function increases by an equal amount for every 5 additional pretzels sold.

23. Two paintings both have a current value of \$15,000. The estimated value of each painting over the next five years is shown in the table below.

Year	Value of the Painting A (\$)	Value of the Painting B (\$)
0	15,000	15,000
1	15,750	15,300
2	16,538	15,606
3	17,364	15,918
4	18,233	16,236
5	19,144	16,561

Which of the following statements describes the value of Painting A relative to the value of Painting B over the next five years?

- A. The value of Painting A increases at a larger constant rate per year than Painting B.
- B. The value of Painting A decreases at a larger constant rate per year than Painting B.
- C. The value of Painting A grows by a larger constant percent rate per year than Painting B.
- D. The value of Painting A decays at a larger constant percent rate per year than Painting B.

24.



Sarah's parents are paying her \$20 to clean out the garage plus an additional \$5 per hour for the number of hours it takes her to complete the job. The graph above represents the money, in dollars, Sarah will earn as a function of the number of hours she works.

Sarah wants to determine how much additional money she will make for every 3 additional hours she works. Her work is shown below.

Additional Hours Worked:

If $x_1 = a$ and $x_2 = a + 3$, then $x_2 - x_1 = 3$.

Additional Money Earned:

If $x_1 = a$, then $y_1 = 5a + 20$.

If $x_2 = a + 3$, then $y_2 = 5(a + 3) + 20$

$y_2 - y_1 = 5(a + 3) + 20 - (5a + 20)$

$= 5a + 15 + 20 - 5a - 20$

$= 15$.

From Sarah's work, which of the following relationships are shown to be true? Select *all* that apply.

- A. The additional money she will earn depends on the value of a .
- B. The additional money she will earn depends on the slope of the line.
- C. For every 3 additional hours she works, she will earn an additional \$15.
- D. The additional money she will earn depends on the value of the y -intercept.

25. The table below shows the approximate number of members with active memberships to Global Fitness and Health Club every year between 2001 and 2006. The equation $y = 350(1.4)^x$ describes the curve of best fit for the number of active memberships.

Let x represent the number of years since 2001.

Year	Population
2001	350
2002	490
2003	690
2004	960
2005	1340
2006	1880

Using this equation, what is the approximate predicted number of memberships which will be active in the year 2011?

- A. 14,170
 B. 10,120
 C. 4580
 D. 2640
26. On an island, the deer population has been decreasing by 4% per year (t). The current population is 792 deer.
- Assume that the deer population continues to decrease by 4% per year. Which of the following logarithmic equations best models the decrease from 792 deer to 674 deer?
- A. $t = \log_{0.04} 0.85$
 B. $t = \log_{0.85} (-0.04)$
 C. $t = \log_{0.85} 1.04$
 D. $t = \log_{0.96} 0.85$
27. The equation $5000 = 2000 \cdot 2^{\frac{t}{36}}$ can be solved to determine the time, t , in years, that it will take for the population of a village to be 5000 people.

Part A:

Write an expression for t involving logarithms that can be used to determine the number of years it will take for the village's population to grow to 5000 people, and explain how you determined your answer.

Part B:

Evaluate the expression from Part A to the nearest tenth.

28. The population of Mathlandia in 1995 was 23,473 and was projected to grow at a rate of 12% per decade. Predict the population in the year 2010.
- A. 976
 B. 27,822
 C. 29,445
 D. 39,435

29. At a high school football game, the amount of concession items sold over the first 5 weeks of the season is shown below.

	Week 1	Week 2	Week 3	Week 4	Week 5
Hot Dogs	142	131	120	109	98
Soft Drink	161	154	147	133	126
Pretzels	64	96	112	120	124
Nachos	97	111	125	139	153

Select *all* of the concession items that show a linear relationship.

- A. hot dogs
 - B. soft drinks
 - C. pretzels
 - D. nachos
30. A scientist is working with a type of antibiotic that will stop bacteria from multiplying. The scientist has 20,000 individual bacteria that he is testing the antibiotic on.
- Once the antibiotic is applied, the bacteria die at a rate of 6% every hour. Which of the following functions models the population of live bacteria, $B(t)$, after t years?
- A. $B(t) = 20,000 + (0.94)^t$
 - B. $B(t) = 20,000 - (0.94)t$
 - C. $B(t) = 20,000 \times (0.94)^t$
 - D. $B(t) = 20,000 \times (1.94)^t$
31. Emergency service personnel are required to follow one another at a safe distance when responding to emergencies. The policy states that it is the responsibility of the driver that is following to be at a minimum of 3 seconds behind the vehicle in front of them. In order to check this, drivers choose a fixed point or object in which the vehicle in front of them passes and count the time it takes for them to pass the same point or object. At lower speeds, the vehicles require less distance between the two vehicles, and vice versa.

Explain how this policy leads to shorter distances at lower speeds and greater distances at higher speeds. As part of your explanation, include the minimum following distances, in feet, for cars traveling at 25 miles per hour and 50 miles per hour.

32. The table below shows a company's annual income over a 6-year period. The equation $y = 60000(1.2)^x$ describes the curve of best fit for the company's annual income (y). Let x represent the number of years since 2001.

Annual Income	
Year	Income
2001	\$58,900
2002	\$72,400
2003	\$86,500
2004	\$103,400
2005	\$124,400
2006	\$150,000

Using this equation, what would be the company's approximate annual income be in the year 2009?

- A. \$179,200
 B. \$258,000
 C. \$309,600
 D. \$642,000
33. A certain bacteria can divide every hour. Which of the following equations represents the number of cells, N , that is present after t hours?
- A. $N(t) = 2t$
 B. $N(t) = \frac{2}{t}$
 C. $N(t) = 2^t$
 D. $N(t) = t^2$

34.

Copies	Toner Left
0	9 oz
1000	8 oz
2000	6 oz
3000	2 oz

Suppose a copy machine uses toner according to the number of copies it has made as in the table above.

Which of the following equations expresses the amount of toner, t , left in the machine based on the number of copies, c , the machine has made?

- A. $t = 10 - 2^{\frac{c}{1000}}$
 B. $t = c^{\frac{1}{3}}$
 C. $t = 1 + 2^{\frac{c}{1000}}$
 D. $t = 2^{\frac{c}{1000}}$

35. Nadia put \$500 in an investment that promised to triple her money every 10 years.

Which of the following equations is a function that will predict, $V(y)$, the value of her investment after y years have passed?

- A. $V(y) = 500 \left(3 \frac{y}{10}\right)$
- B. $V(y) = 500(3)^{\frac{y}{10}}$
- C. $V(y) = 500 + 3^{\frac{y}{10}}$
- D. $V(y) = (500)(3)\left(\frac{y}{10}\right)$

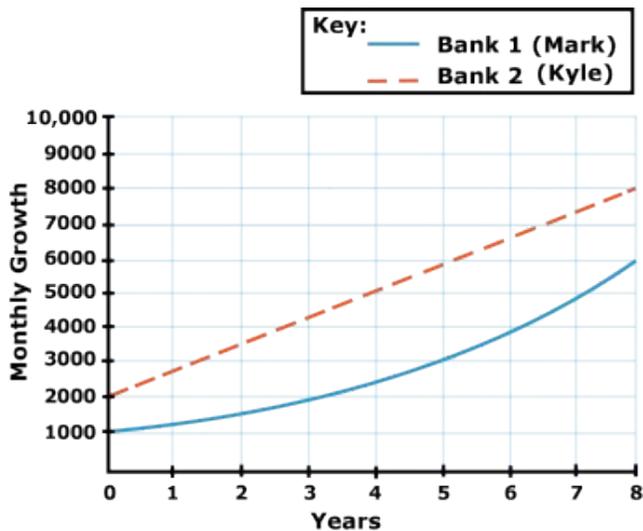
36. The table below shows the estimated population of fish living in the local lake as determined by the local environment council every 10 years between 1960 and 1990. The equation $y = 1500(.9)^x$ describes the curve of best fit for the fish population (y). Let x represent the number of 10-year intervals since 1960.

Year	Population
1960	1500
1970	1350
1980	1210
1990	1100

Using this equation, what is the approximate predicted population of fish living in the lake in the year 2020?

- A. 720
- B. 770
- C. 800
- D. 980
37. Which of the following equations could be used to predict the value, $V(t)$, after t years, of a \$1000 investment expected to appreciate by 5% each year?
- A. $V(t) = 1000(0.5)^t$
- B. $V(t) = 1000(1 + 0.5)^t$
- C. $V(t) = 1000(0.05)^t$
- D. $V(t) = 1000(1 + 0.05)^t$

38.



Mark and Kyle put their money in different banks with different amounts deposited. Mark went to Bank 1 and Kyle went to Bank 2. They each made a graph of what the interest would look like for subsequent years.

If the interest rates for both banks continue at their current rates, who will have more money by year 20?

- A. Mark, because his interest is increasing linearly.
- B. Mark, because his interest is increasing exponentially.
- C. Kyle, because his interest is increasing linearly.
- D. Kyle, because his interest is increasing exponentially.

39. The table below shows the population of Twistville as reported to the census bureau every 10 years between 1940 and 1990. The equation $y = 5000(1.2)^x$ describes the curve of best fit for the town population (y). Let x represent the number of 10-year intervals since 1940.

Population of Twistville	
Year	Population
1940	5,002
1950	6,013
1960	7,118
1970	8,632
1980	10,370
1990	12,471

Using this equation, what is the predicted approximate population of Twistville in the year 2020?

- A. 21500
- B. 17900
- C. 17500
- D. 14900

40. A grad student is experimenting on a new strain of bacteria. What would be the population of bacteria after 3 hours if he started with 45 bacteria that doubled every 10 minutes?

- A. 360
- B. 1620
- C. 2700
- D. 11,796,480

41. A sample of two bacteria strains are being studied at a lab:

After h hours, the population of Bacteria M is modeled by $M(h) = 20(1.8)^h$, and the population of Bacteria N is modeled by $N(h) = 30(1.65)^h$.

When is the population of Bacteria M greater than the population of Bacteria N ?

- A. The population of Bacteria M is always greater than the population than Bacteria N .
- B. The population of Bacteria M is never greater than the population than Bacteria N .
- C. The population of Bacteria M is greater until a point between hours 4 and 5, after which Bacteria N has the greater population.
- D. The population of Bacteria N is greater until a point between hours 4 and 5, after which Bacteria M has the greater population.

42.

Year	Value
1	\$400
2	\$800
3	\$1600
4	\$3200

Suppose the value of a rare coin changes according to the above table.

Which of the following equations does *not* express the value, v , of the coin at any given year, t ?

- A. $v = 100(2)^{t+1}$
- B. $v = 400(2)^{t-1}$
- C. $v = 200(2)^t$
- D. $v = 100(2)^t$

43. Which of the following situations can be modeled by a function whose value changes at a constant rate per unit of time? Select *two* that apply.

- A. The population of a city is increasing 5% per year.
- B. The water level of a tank falls by 5 gallons every day.
- C. The number of reptiles in the zoo increases by 5 reptiles each year.
- D. The amount of money collected by a charity increases by 5 times each year.

44. Tommy's parents offered him two different allowance choices. His choices are shown in the table below.

Week	1	2	3	4
Choice 1	\$0.01	\$0.02	\$0.04	\$0.08
Choice 2	\$1.00	\$2.00	\$3.00	\$4.00

Tommy's parents told him that the pattern shown for choice 1 and choice 2 would continue. During which week will choice 1 exceed choice 2?

- A. week 10
 B. week 12
 C. week 50
 D. week 100
45. Which of the following functions will have the greatest value when $x = 5000$?

A.	<table border="1"> <tr><td>x</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr> <tr><td>$f(x)$</td><td>8</td><td>12</td><td>18</td><td>27</td><td>40.5</td></tr> </table>	x	1	2	3	4	5	$f(x)$	8	12	18	27	40.5
x	1	2	3	4	5								
$f(x)$	8	12	18	27	40.5								
B.	<table border="1"> <tr><td>x</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr> <tr><td>$f(x)$</td><td>16</td><td>64</td><td>144</td><td>256</td><td>400</td></tr> </table>	x	1	2	3	4	5	$f(x)$	16	64	144	256	400
x	1	2	3	4	5								
$f(x)$	16	64	144	256	400								
C.	<table border="1"> <tr><td>x</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr> <tr><td>$f(x)$</td><td>2</td><td>16</td><td>54</td><td>128</td><td>250</td></tr> </table>	x	1	2	3	4	5	$f(x)$	2	16	54	128	250
x	1	2	3	4	5								
$f(x)$	2	16	54	128	250								
D.	<table border="1"> <tr><td>x</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr> <tr><td>$f(x)$</td><td>110</td><td>220</td><td>330</td><td>440</td><td>550</td></tr> </table>	x	1	2	3	4	5	$f(x)$	110	220	330	440	550
x	1	2	3	4	5								
$f(x)$	110	220	330	440	550								

46. As time, t , passes, the concentration of organisms in a seawater sample is modeled by the function: $C(t) = 0.80(1.2)^t$

Which of the following statements is supported by the behavior of $C(t)$?

- A. According to $C(t)$, the concentration of organisms will decrease over time.
 B. According to $C(t)$, the concentration of organisms will increase over time.
 C. According to $C(t)$, the concentration of organisms will remain the same.
 D. No generalizations can be made because $C(t)$ will both increase and decrease over time.
47. Ian has a bank account that earns interest. The value, V , in dollars, of Ian's account after t years can be modeled by the exponential function $V(t) = 5000(1.025)^t$.

Ian claims that the value of his bank account grows by an equal factor each year. To prove his claim, which equation must he show to be true?

- A. $\frac{V(t)}{V(t+1)} = 1.025$
 B. $\frac{V(t+1)}{V(t)} = 1.025$
 C. $V(t) - V(t+1) = 1.025$
 D. $V(t+1) - V(t) = 1.025$

48. Consider the function: $f(x) = m(1.1)^x$

If $m > 0$, which of the following is true?

- A. $f(3) = f(5)$
- B. $f(3) > f(5)$
- C. $f(3) < f(5)$
- D. There is not enough information to answer this question.

49. A homeowner looked at her electric bill over the past six months and noticed that the bill has been increasing as is shown below.

Month	Amount
August	\$64.20
September	\$67.41
October	\$70.79
November	\$74.30
December	\$78.02
January	\$81.94

Which type of function *best* models the homeowner's electric bill over the past six months?

- A. linear
 - B. exponential
 - C. cubic
 - D. quadratic
50. A teacher looked at the amount of assignments that his students turned in at the start of the trimester (week 1) versus the end of the trimester (week 12). He noticed that the amount of homework that the students turned in each week can be modeled by a linear function.

In week one, his students turned in 354 assignments. In week 12, they turned in 266 assignments. What is the rate of change in assignments per week?

- A. $-7\frac{1}{3}$
- B. -8
- C. -44
- D. -88

51. **Newton's Law of Cooling** is used by forensic scientists to determine time of death and is written as follows:

$$T(t) = T_s + (T_0 - T_s)e^{-kt}$$

In the formula, T_0 is the initial temperature of a body, T_s is the surrounding temperature of the environment, e and k are constants, and $T(t)$ is the temperature of the body after t hours.

Suppose that in the 1 hour since a body was found, it has cooled from 84 °F to 82 °F when the surrounding temperature was 70 °F. First plug these numbers into the appropriate places in the formula and solve for k . Write the value of k as a logarithmic expression.

Now assume that the temperature of the body at time of death was 98 °F. Use this temperature, along with the current body temperature of 82 °F and the surrounding temperature of 70 °F, in the formula and solve for t . Write the value of t as a logarithmic expression and keep k in the expression.

Finally, substitute the expression for k that you found in the first part of this problem into the expression that you found in the second part. The resulting expression represents the number of hours since the time of death.

52. **Scientists studying a bacteria sample** find that after starting with 120 cells, the number of cells doubles every hour.

Which of the following equations is a function that will predict, $C(h)$, the number of cells after h hours have passed?

- A. $C(h) = 120(2^h)$
- B. $C(h) = 120(2)^h$
- C. $C(h) = 120 + 2^h$
- D. $C(h) = (120)(2)(h)$

53. **Jill has a coin collection.** She currently has 40 coins and will add 2 new coins to her collection each month. She models this situation with the linear function $C(m) = 40 + 2m$, where C is the number of coins in her collection and m is the number of months that have passed.

Which statement *best* describes the appropriateness of her model?

- A. The model is not appropriate since the two variables are related exponentially.
- B. The model is not appropriate since the domain of the function must be integral values.
- C. The model is appropriate since there is a constant rate of change between the two variables.
- D. The model is appropriate since there is a constant percent rate of change between the two variables.

54. **Mark buys a used car for \$12,000.** The value of the car depreciates 10% per year from the time he bought the car.

The value of Mark's car, $V(t)$, can be represented by which of the following functions?

- A. $V(t) = -0.90t + 12,000$
- B. $V(t) = -0.10t + 12,000$
- C. $V(t) = 12,000(0.10)^t$
- D. $V(t) = 12,000(0.90)^t$

55. The table below shows the value of Alan's home over a 4-year period. The equation $y = 250,000(1.1)^x$ describes the curve of best fit for the value of his home (y). Let x represent the number of years since 2002.

Year	Income
2002	\$250,000
2003	\$275,000
2004	\$302,500
2005	\$332,800

Using this equation, what would be the approximate value of Alan's house in the year 2007?

- A. \$442,900
 - B. \$402,600
 - C. \$393,400
 - D. \$336,000
56. Mr. Stein receives a water bill from city hall. He notices that the city charges \$50 for fire and sewer service and \$3 for every 1000 gallons of water used. Mr. Stein wants to construct a model describing the relationship between the cost of his water bill and the amount of water he uses.

Which statement *best* describes the model that Mr. Stein should create?

- A. Mr. Stein should use a linear model, since the water bill changes at a constant rate relative to the amount of water he uses.
 - B. Mr. Stein should use an exponential model, since the water bill changes at a constant rate relative to the amount of water he uses.
 - C. Mr. Stein should use a linear model, since the water bill changes at a constant percent rate relative to the amount of water he uses.
 - D. Mr. Stein should use an exponential model, since the water bill changes at a constant percent rate relative to the amount of water he uses.
57. Becca owns a small business that makes candles. The linear function, $f(c) = 12 + 2c$ shows the number of candles, c , that Becca makes each day, where $f(c)$ represents the number of days since her business has been open.

Becca wishes to prove that a linear function grows by equal amounts over equal intervals. Select *all* choices that allow her to prove this.

- A. $f(c - 1) - f(c - 5) = 8$
- B. $f(c - 3) - f(c - 4) = 12$
- C. $f(c + 2) - f(c + 4) = -4$
- D. $\frac{f(c - 1)}{f(c - 2)} = 2$
- E. $\frac{f(c + 5)}{f(c + 3)} = 24$

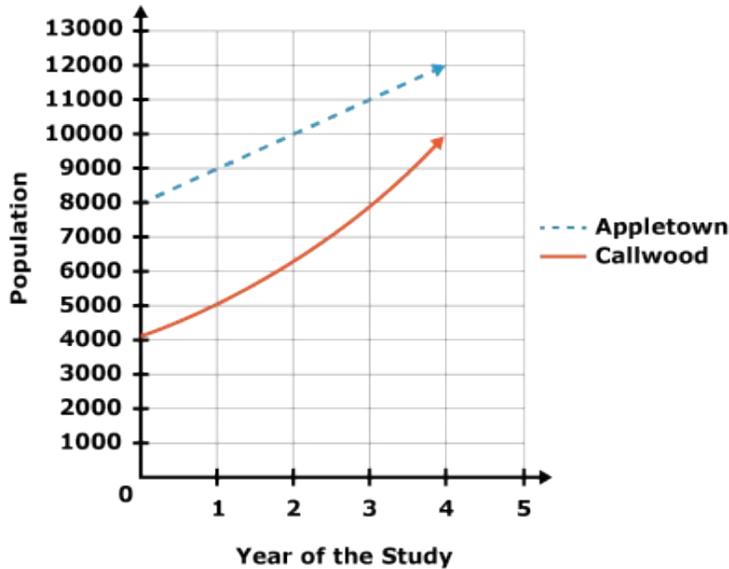
58. Newton's law of cooling is used in the following formula to cool a certain substance down from 89° to 80° if the substance is located in a 75° room.

$$80 = (89 - 75)e^{-0.094t} + 75$$

What is the value of this expression when it is solved for t ?

- A. $t = \frac{\frac{\ln 5}{14}}{-0.094}$
- B. $t = \frac{\ln\left(\frac{5}{14}\right)}{-0.094}$
- C. $t = \frac{\log\left(\frac{80}{14} - 75\right)}{-0.094}$
- D. $t = \frac{\log 80 - 75}{14 - 0.094}$

59. **Town Population Study**

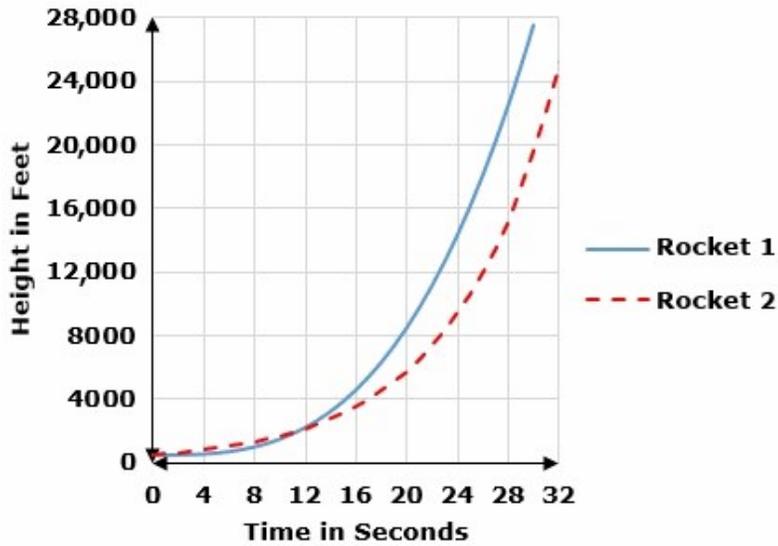


In order to predict future housing needs the population of two towns, Appletown and Callwood, have been monitored and plotted on a graph for the past four years. The results are shown on the graph above.

If both towns continue to grow at their current rates, which town will have the largest population at year 10 of the study?

- A. Appletown because it is increasing linearly.
- B. Appletown because it is increasing exponentially.
- C. Callwood because it is increasing linearly.
- D. Callwood because it is increasing exponentially.

60.



Dan and Tim made model rockets. Dan has Rocket 1 and Tim has Rocket 2. Both launch their rockets at the same time. At 11 seconds, both rockets are at about the same height. If both rockets continue to increase in height at the same rates, which rocket will be the highest at 40 seconds?

- A. Rocket 1 because it is increasing at an exponential rate.
- B. Rocket 1 because it is increasing at a polynomial rate.
- C. Rocket 2 because it is increasing at an exponential rate.
- D. Rocket 2 because it is increasing at a polynomial rate.

61. The employee of a tour guide company writes the exponential function $S(t) = 35(1.025)^t$ to model her salary, S , in thousands of dollars, after t years of working at the company.

The employee claims that her salary grows by an equal factor each year. To prove her claim, what must she show to be the value of $\frac{S(t+1)}{S(t)}$ for all values of t for which the function models

her salary?

- A. 1.025
- B. 2.5
- C. 35
- D. 35.875

62. A student is asked to write a report about the population growth of two countries A and B. The population of these two countries over the past five years is shown in the table below. The population of both countries is expected to continue to grow at the same rate.

Year	Population of Country A	Population of Country B
2009	60,000	105,000
2010	66,000	110,000
2011	72,600	115,000
2012	79,860	120,000
2013	87,846	125,000

Which of the following statements can the student use in their report to accurately describe the population of Country A? Select *two* that apply.

- A. It is increasing linearly.
 - B. It is increasing exponentially.
 - C. It is decreasing each year at a constant rate.
 - D. It will eventually exceed the population of Country B.
 - E. It will always be less than the population of Country B.
63. A school district currently has 12,000 students. Based on declining enrollment figures, the number of students in the school district is expected to decline by 5% each year. Which of the following functions represents the number of students, S , in the school district after n years?
- A. $S(n) = 12,000(-5)^n$
 - B. $S(n) = 12,000(0.95)^n$
 - C. $S(n) = 12,000(1.05)^n$
 - D. $S(n) = 12,000(-0.05)^n$