

Mathematics I Resources for EOC Remediation

F.LE – Linear, Quadratic and Exponential Models:

HSF-LE.A.1

HSF-LE.A.2

HSF-LE.B.5

The information in this document is intended to demonstrate the depth and rigor of the Nevada Academic Content Standards. The items are **not** to be interpreted as indicative of items on the EOC exam. These are a collection of standard-based items for students and **only** include those standards selected for the Math I EOC examination.

LE Linear, Quadratic & Exponential Models Cluster

HSF-LE.A.1 Distinguish between situations that can be modeled with linear functions and with exponential functions.

HSF-LE.A.1.a Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.

HSF-LE.A.1.b Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.

HSF-LE.A.1.c Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

1. Do the ordered pairs (x, y) from the table below form a linear function? Explain your answer.

x	3	5	8	12	17
y	12	16	22	30	40

Answer: Yes, there is a constant rate of increase of 2 between all ordered pairs.

2. How does the function represented in the table change over equal intervals? What does this tell you about the type of function it is?

x	5	7	9	11
$f(x)$	30	26	22	18

Answer: Over equal intervals, there is a constant rate of change of -4. This means it is a linear function.

3. Consider the function, $p(x) = 2(2^x)$. Evaluate $p(x)$ for $x = -3, 0, 3, 6, 9$ and show your work. Then, show that the exponential function grows by equal factors over those 3-unit intervals.

Answer: The table shows that $p(x)$ grows by equal factors of 8 over 3-unit intervals.

x	-3	0	3	6	9
y	1/4	2	16	128	1024

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4. Name the type of function represented by each table and explain your reasoning:

Part 1:

x	0	3	5	8
y	3	6	8	11

Part 2:

x	0	3	5	8
y	2	16	64	512

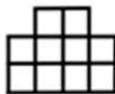
Answer: Part 1: Linear because there is a constant rate of change of 1.

Part 2: Exponential because there is a constant multiple of 2.

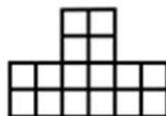
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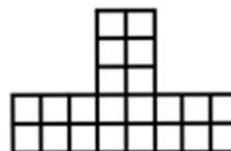
Step 1



Step 2



Step 3



Step 4

Part 1: Write a function that describes the perimeter of the figure in relation to the step.

Part 2: Is the function linear, exponential or neither? How can you tell?

Answer: Part 1: Let $n = \text{step \#}$, $f(n) = 6n + 2$, **Part 2:** Linear, because there is a constant rate of change.

6. A student notices that the value of $f(2)$ is 8% less than $f(1)$. He also noticed that $f(3)$ is 8% less than $f(2)$.

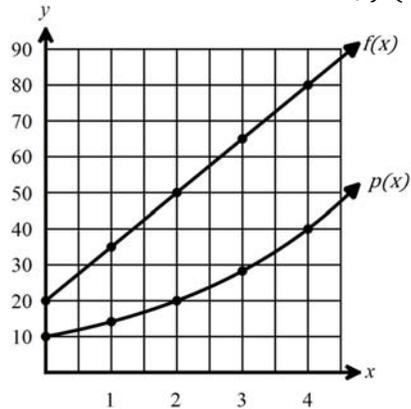
Part 1: Can this situation be modeled by a linear or exponential function? Explain your reasoning.

Part 2: Create a function that describes this situation.

Answer: Part 1: Exponential, **Part 2:** $f(x) = A(1 - 0.08)^x$ or $f(x) = A(0.92)^x$

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7. The graph below shows two functions, $f(x)$ and $p(x)$.



Part 1: Which function grows by the same factor over equal intervals? How do you know?

Part 2: The domains of f and p are non-negative, real numbers. Are there values of x for which $p(x) > f(x)$? Explain.

Answer: Part 1: Function p doubles over each interval of 2 units, **Part 2:** Yes, because $p(x)$ is an exponential function and $f(x)$ is a linear function, $p(x)$ will grow faster as x gets larger and it will eventually exceed $f(x)$.

HSF-LE.A.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).

1. There are a total of 128 teams at a video game tournament. Half of the teams are eliminated after each round.

Part 1: Write a function, $f(x)$, for the number of teams left after x rounds.

Part 2: Make a table for the function using $x = 0, 2, 3, 7$.

Answer: Part 1: $f(x) = 128 \cdot \left(\frac{1}{2}\right)^x$, **Part 2:**

x	0	2	3	7
$f(x)$	128	32	16	1

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2. The population of Anytown, NV in 2007 was approximately 87,000. The population is growing by approximately 1.5% per year.

Part 1: If $P(n)$ represents the populations of Anytown n years after 2007, write a formula to model the population n years after 2007.

- A. $P(n) = 2007(1.5)^n$
- B. $P(n) = 87,000(1.015)^n$
- C. $P(n) = 87,000(1.15)^{2007-n}$
- D. $P(n) = 87,000(1.015)$

Part 2: Use your model from Part A to determine the population of Anytown in 2012 to the nearest thousand.

Answer: Part 1: B, Part 2: 94,000

3. Several years ago there was an outbreak of the Bovo virus. The CDC tracked the virus and discovered that for the first 5 years, the virus had a fatality rate of approximately 7%. The CDC discovered a partial cure that decreased the fatality rate to approximately 2% for the next 3 years, after which a full cure was developed and administered to all of the infected population. Identify the expression that correctly reflects the current population after the cure was administered. Let P equal the initial population.

- A. $P_{(final)} = P(1.07)^5(1.02)^3$
- B. $P_{(final)} = P(1.045)^8$
- C. $P_{(final)} = 5P(1.07)3P(1.02)$
- D. There is not enough information to complete this problem.
- E. $P_{(final)} = P(1.05)^8$
- F. $P_{(final)} = P(0.93)^5(0.98)^3$
- G. $P_{(final)} = P(0.93)^5(0.95)^3$

Answer: F. $P_{(final)} = P(0.93)^5(0.98)^3$

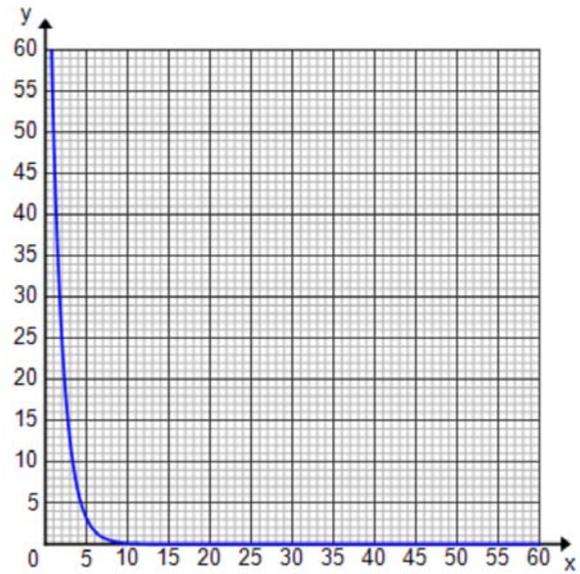
4. An ultra marathon lasts for 12 hours. After each hour, the slowest 25 racers are eliminated from the race. If the race starts with 535 runners, construct a function to represent this situation. Then, find out how many runners will be left after 3 hours and how many will be left after 9 hours.

Answer: the number of runners = $535 - 25h$, 460 runners, 310 runners

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5. Two of the points that lie on the function in the figure are; (1,50) and (2,25).

Find the exponential function to model this graph.



Answer: $f(x) = 100\left(\frac{1}{2}\right)^x$

6. The table of ordered pairs represents an exponential function. Write the function represented.

x	-1	0	1	2
$f(x)$	96	16	$\frac{8}{3}$	$\frac{4}{9}$

Answer: $f(x) = 16\left(\frac{1}{6}\right)^x$

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HSF-LE.B.5 Interpret the parameters in a linear or exponential function in terms of a context.

1. The pressure in a car tire is given by $P(x) = 34 - x$ where p is the pressure in psi and x is the number of months since the tire was filled.

Part 1: Is the tire pressure increasing, decreasing, or staying constant? Explain how you know.

Part 2: What is the initial tire pressure?

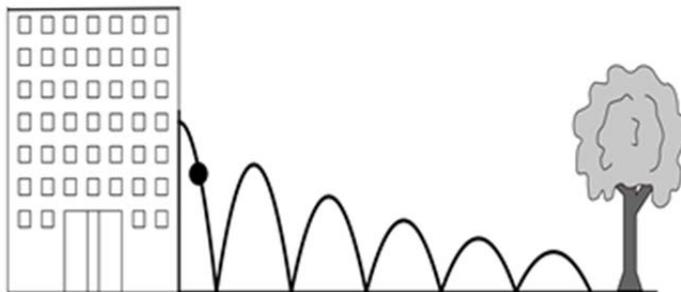
Answer: Part 1: decreasing; since the slope is negative the tire loses pressure over time,

Part 2: 34 psi

2. A cable company has noticed that its ad campaign has been paying off. It's been gaining y customers over x months since the ads started as modeled by the equation, $y = 500x + 5000$. How many customers did the cable company have before the ads started playing? How long until the company will have at least 40,000 customers?

Answer: 5,000 customers; 70 months

3. A ball is dropped from a height of 64 feet. It rebounds three-fourths of the height from which it falls every time it hits the ground. Identify the initial height, the decay rate and the percent of the decay rate.



Answer: Initial height = 64 feet, Decay rate = $1/4$, Percent of rate = 25%

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4. Four friends deposited money into savings accounts. The amount of money in each account is given by the functions below:

$$\text{Jan: } J(t) = 100(1.01)^t$$

$$\text{Dan: } D(t) = 200(1.04)^t$$

$$\text{Stan: } S(t) = 300(1.05)^t$$

$$\text{Fran: } F(t) = 400(1.03)^t$$

Part 1: Who has the largest initial deposit? Explain.

Part 2: Whose interest rate is the lowest? Explain.

Answer: Part 1: Fran, initial amount \$400, **Part 2:** Jan has the lowest interest rate of 1%

5. The maximum height reached by a bouncing ball is given by $h(x) = 7(0.8)^x$ where h is measured in feet and x is the bounce number.

Part 1: Describe the percent of change in the height of the ball after each bounce.

Part 2: Describe what it means when $x = 0$.

Answer: Part 1: The height of the ball decreases by 20% each bounce, **Part 2:** When $x = 0$, there has not been any bounce, which means the ball is at its initial height of 7 feet

6. Recovering from the brink of extinction, the Asian lion population on the Gir Forest National Park bounced back and began to steadily increase the lion population. The population can be predicted using the expression $395(1.05)^x$, where x is the number of years since 2010.

What does the value of 395 represent?

- A. the percentage the lion population is predicted to increase each year
- B. the year the lion population is predicted to stop increasing
- C. the number of lions in the park in 2010
- D. the predicted increase in the number of lions in the park each year

Answer: C

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7. You invest an amount of money in a mutual fund. After four years, the balance of your account is \$1,669.43 and after ten years it is \$2576.29.

Part 1: If you were to graph this trend, what would the coordinates of your points be?

Part 2: Assuming the interest rate is constant from year to year and compounds annually, what was the initial amount you invested? The interest rate? Explain how you determined these values?

Answer: Part 1: (4, 1669.34) and (10, 2576.29)

Part 2: 7.5% interest rate, \$1250 initial amount

8. The owner of a taxi cab service needs to raise fares. Currently each fare is made up of a base fee of \$1.90 plus a charge of \$0.30 for each one-fifth of a mile traveled.

Part 1: The owner is considering two options: raise the base fee to \$2.50, or raise the fee for each one-fifth of a mile to \$0.35. Describe each option using an equation in which F represents the total fare for a ride and n represents the number of one-fifths-of-a-mile traveled.

Part 2: Assume the company averages 200 fares each day and the average trip length is 3.0 miles. Also assume that those numbers will not be changed by either type of fare increase. Determine whether increasing the charge for each one-fifth of a mile just a little, from \$0.30 to \$0.35, or increasing the base fee by a larger amount, from \$1.90 to \$2.50, raises the daily revenue more. Explain your reasoning.

Answer: Part 1: Raising the base fee results in each fare equation, $F = 0.30n + 2.50$. Raising the fee for mileage results in each fare equation, $F = 0.35n + 1.90$. The original fare equation for each fare is: $F = 0.30n + 1.90$. **Part 2:** 200 fares would mean 200 base fees per day. Since there are five one-fifth miles in each mile, the average trip would equal 15 (one-fifth-mile) units. Raising the base fee-rate to \$2.50 for 200 fares and miles will generate $\$7.00(200) = \1400 . Raising the proposed mileage-fee rate to 0.35 for 200 trips generates $\$7.15(200) = \1430 . Therefore, increasing the mileage fee-rate to \$0.35 per unit would result in greater revenue for the taxi cab company.

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9. The tuition at a private college can be modeled by the equation $T(y) = 30000(1.07)^y$ where y is the number of years since 2000.

Part 1: What was the tuition in the year 2000?

Part 2: A student claims the growth rate is 107%. Is she correct? Explain.

Answer: Part 1: \$30,000, **Part 2:** 107% is not correct. It is a 7% growth rate because $1.07 = 1 + 0.07 = 1 + r$, where $r = 0.07$ or 7%
