

Linear and Exponential Functions (2.2+2.3) Homework

1. (Calculator Allowed) Bruce made a bad deal with his loan shark. He borrowed \$1000, but every year the amount he owes gets doubled! One year after borrowing, Bruce owed \$2000. Two years after borrowing, Bruce owed \$4000.
 - a. How much did Bruce owe after ten years (assuming he didn't pay anything back during that decade)?
 - b. Bruce assumed that during first year he would owe only \$1000, and that the amount owed would increase on the anniversary of the loan. Then he'd only owe \$2000 and it would stay that way until exactly two years had passed. He was wrong. Actually, the amount Bruce owes is continually increasing exponentially in such a way that it just works out that every year the quantity doubles. How much should Bruce owe after 1.5 years? (This will require a calculator. Round to the nearest cent.)
 - c. Ray heard that after three years Bruce owed \$8000 and that after five years Bruce owed \$32,000. But Ray assumed the amount owed grew linearly. If Ray were correct and the amount actually grew linearly, how much would Bruce owe after eight years?
2. (Calculator Allowed) After running it for 22 minutes, Philip's boat has 10.4 gallons of fuel remaining. After running it for 46 minutes, Philip's boat has 9.6 gallons of fuel remaining. Assume that the fuel level of Philip's boat decreases linearly.
 - a. Let $f(t)$ represent the fuel level of Philip's boat after the boat has been run for t minutes. Find the average rate of change of $f(t)$, in gallons per minute, over the interval $22 \leq t \leq 46$. Express your answer as a decimal approximation. Show the computations that lead to your answer.
 - b. After the boat has run for 100 minutes, how many gallons of fuel are left in the tank?
 - c. After how many minutes of running is the boat out of fuel?
3. (Calculator Needed) The price of an ounce of gold was \$1500 on January 1st of 2020. The price of gold was \$1800 on January 1st of 2023. Assume the price of gold grows exponentially (in the long term, the price of commodities like gold tend to grow exponentially. This is called inflation. But on a day-to-day basis the prices can vary due to geopolitics and speculation).
 - a. Predict the price of gold on January 1st of 2025. Round to the nearest cent.
 - b. Predict the price of gold on July 1st of 2025. Round to the nearest cent.
4. Darla is an air conditioning repair technician. She charges \$50 to evaluate your air conditioning system and then charges an additional \$28 for each hour it takes to complete the repair job. Write a function that may be used to calculate how much Darla charges in terms of t , the amount of time it takes her to complete a repair.
5. (Calculator Allowed) Gil owns an autograph from Willem Dafoe. Willem Dafoe is a famous actor which makes his autograph have some value. Gil got it appraised and was told that its value can be expected to increase by the same amount every year. If it was worth \$500 in 2020 and \$820 in 2024, predict how much the autograph will be worth in 2030.

6. Use the table of values of each function to determine if that function is best modeled by a linear, quadratic, cubic, or exponential function. Justify each choice by completing the sentence “Consecutive equally spaced input values correspond with output values that...”

a.

x	-3	0	3	6	9	12
$f(x)$	11	7	6	8	13	21

b.

x	8	10	12	14	16	18
$g(x)$	$2/3$	6	14	26	44	71

c.

x	1	2	3	4	5	6
$h(x)$	21	16	11	6	1	-4

d.

x	-10	-5	0	5	10	15
$k(x)$	243	81	27	9	3	1

7. Below are select values of the **linear** function $f(x)$. Find the missing function value.

x	2	5	9	10	12
$f(x)$	11	?	46	51	61

8. Below are select values of the **exponential** function $g(x)$. Find the missing function value.

x	6	9	12	15	18	21
$g(x)$	-17	?	-8	4	28	76

Match each numbered function below with the letter of the corresponding description.

9. $f(x) = -2\left(\frac{3}{4}\right)^x$

(A) This function increases at an increasing rate

10. $g(x) = \frac{1}{3}(4)^{-x}$

(B) This function decreases at a decreasing rate

11. $h(x) = 5(2.7)^x$

(C) This function increases at a decreasing rate

12. $k(x) = -\frac{3}{2}(5)^x$

(D) This function decreases at an increasing rate

13. Let $f(x) = -2(4)^{-x}$

- Is this function increasing or decreasing?
- Is this function concave up or concave down?
- Is this function positive or negative?
- Is the rate of change of this function positive or negative?
- Is the rate of change of this function increasing or decreasing?
- Find the x -values of all relative maxima of this function.
- Find all relative minima of this function. (Note: this question is asking for y -values, not x -values)
- Find all points of inflection on the graph of this function.
- Determine the end behavior of f as x increases without bound. Use limit notation.
- Determine the end behavior of f as x decreases without bound. Use limit notation.

Linear and Exponential Functions (2.2+2.3) HW Answers

1.
 - a. \$1,024,000
 - b. \$2828.43
 - c. \$68,000
2.
 - a. Average Rate of Change = $\frac{f(46)-f(22)}{(46 \text{ min})-(22 \text{ min})} = \frac{(9.6 \text{ gal})-(10.4 \text{ gal})}{(46 \text{ min})-(22 \text{ min})} = \frac{-0.8 \text{ gal}}{24 \text{ min}} = -\frac{1 \text{ gal}}{30 \text{ min}} = -0.033 \frac{\text{gal}}{\text{min}}$
 - b. 7.8 gal
 - c. 334 minutes
3.
 - a. \$2032.64
 - b. \$2095.35
4. $f(t) = 50 + 28t$
5. \$1300
6.
 - a. Quadratic. Consecutive equally spaced input values correspond with output values that have a constant second difference.
 - b. Exponential. Consecutive equally spaced input values correspond with output values for which the first differences change proportionally.
 - c. Linear. Consecutive equally spaced input values correspond with output values that have a constant first difference.
 - d. Exponential. Consecutive equally spaced input values correspond with output values for which the first differences change proportionally.
7. 26
8. -14
9. C
10. D
11. A
12. B
13.
 - a. $f(x)$ is increasing (AKA the rate of change of $f(x)$ is positive)
 - b. $f(x)$ is concave down (AKA the rate of change of $f(x)$ is decreasing)
 - c. $f(x)$ is negative
 - d. The rate of change of $f(x)$ is positive (this question was the same thing as part a)
 - e. The rate of change of $f(x)$ is decreasing (this question was the same thing as part b)
 - f. None
 - g. None
 - h. None
 - i. $\lim_{x \rightarrow \infty} f(x) = 0$
 - j. $\lim_{x \rightarrow -\infty} f(x) = -\infty$