

Modeling Linear Situations

A 747 airliner has an initial climb rate of 1800 feet per minute until it reaches a height of 10,000 feet.

Identify the independent and dependent variables and their unit of measures.

Independent- time (min)

Dependent- height (feet)

Which function family do you think best represents this situation? *Explain.*

linear. as the time increases so does the height of the plane.

Write the independent and dependent quantities and their units of measure in the table. Then calculate the dependent quantity values for each of the independent quantity values given.

	Independent Quantity	Dependent Quantity
Quantity	time	height
Units	min	feet
	0	0
	1	1800
	2	3600
	2.5	4500
	3	5400
	3.5	6300
	5	9000
Expression	t	$1800t$

Let's examine the table to determine the unit rate of change for this situation. One way to determine the unit rate of change is to calculate *first differences*. Recall that first differences are determined by calculating the difference between successive points.

Determine the first differences in the section of the table shown.

	Time (minutes)	Height (feet)	First Differences
$1 - 0 = 1$ <	0	0	
$2 - 1 = 1$ <	1	1800	1800
$3 - 2 = 1$ <	2	3600	1800
	3	5400	1800

What do you notice about the first differences in the table? Explain what this means. *They are the same. The plane increases by the same amt. each time.*
 Another way to determine the unit rate of change is to calculate the rate of change between any two ordered pairs and then write each rate with a denominator of 1.

Calculate the rate of change between the points represented by the given ordered pairs in the section of the table shown. Show your work.



These numbers are not consecutive. I wonder if that is why I have to use another method.

Time (minutes)	Height (feet)
2.5	4500
3	5400
5	9000

Remember, if you have two ordered pairs, the rate of change is the difference between the output values over the difference between the input values.

* Slope Formula *

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

(2.5, 4500) and (3, 5400)

$$ROC = \frac{5400 - 4500}{3 - 2.5} = \frac{900}{.5} = \frac{1800}{1}$$

(3, 5400) and (5, 9000)

$$ROC = \frac{9000 - 5400}{5 - 3} = \frac{3600}{2} = \frac{1800}{1}$$

(2.5, 4500) and (5, 9000)

$$ROC = \frac{9000 - 4500}{5 - 2.5} = \frac{4500}{2.5} = \frac{1800}{1}$$



Practice:

Roman shovels snow for winter work and charges \$20 per sidewalk.

1. Identify the independent and dependent quantities in this problem situation.

Independent - # sidewalks

Dependent - \$ earned

2. Suppose s represents the number of sidewalks Roman shoveled and $P(s)$ represents the profit Roman makes shoveling sidewalks.

Complete a table of values to describe this situation.

	Sidewalks	Dollars
	0	0
	1	20
	2	40
	3	60
	4	80
Expression	5	100

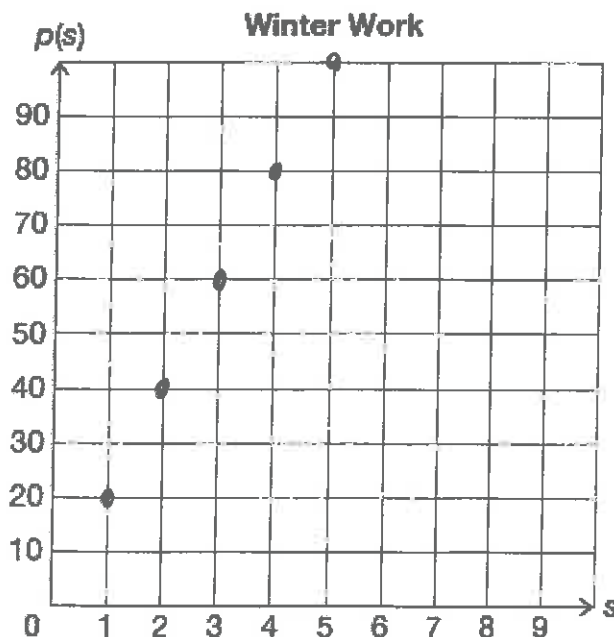
3. Does the table of values describe a function? Why or why not?

yes. each x value goes to only 1 y -value.

4. Write an equation in function notation to represent this problem situation.

$$f(x) = 20x$$

5. Sketch the graph of this problem situation and label the axes.



6. Is your graph continuous or discrete? Explain!

discrete. - you get paid per sidewalk

7. What family of functions is best associated with this problem situation table equation and graph.

linear

What do you notice about the rates of change?

They are all the same.

What is the difference between a rate of change and a unit rate of change?

R.O.C. = is a rate between the 2 quantities. The denominator does not have to be 1

Unit R.O.C. = the denominator must be a 1

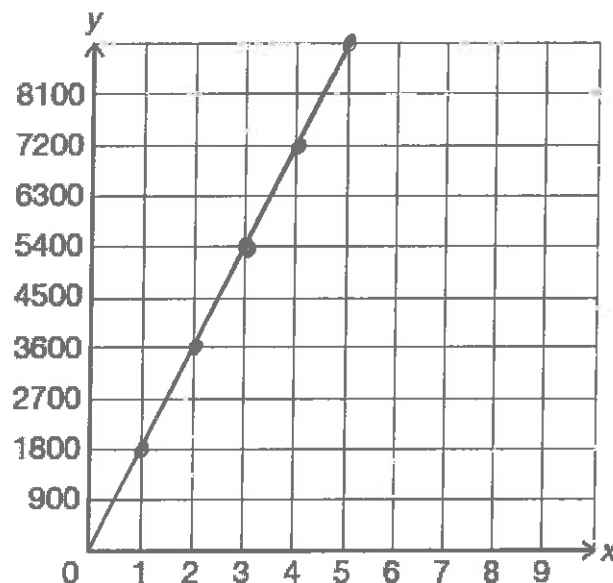
How do the first differences and the rates of change between ordered pairs demonstrate that the situation represents a linear function? Explain your reasoning.

The 1st differences are all the same as are the rate of changes making the function linear.

Write a function $h(t)$, to describe the plane's height over time t .

$$h(t) = 1800t$$

Use your table and function to create a graph to represent the change in the plane's height as a function of time. Be sure to label your axes with the correct units of measure and write the function.



What is the slope of this graph?

$$\text{slope} = \frac{1800}{1}$$

The function is $h(t) = 1800t$ so it is in $y = mx + b$ form making the slope $1800/1$