5.1 Representing Patterns – part 2
(pp. 158-162)

Name: ______________
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Learning Goals: *I will learn to*
- represent pictorial, oral and written patterns with equations
- identify fixed and variable values
- solve problems that involve pictorial, oral and written patterns using an equation

A **table of values** is one way to represent a pattern.

In a linear relation, a consistent change in one column (or row) corresponds with a consistent change in the other column (or row).

Examples

Determine if each table of values represents a linear relation. How do you know?

+15 +15 +15

Distance (m)	0	15	30	45
Speed (m/s)	2.1	4.2	6.3	8.4

+2.1 +2.1 +2.1

$\boxed{\text{YES}}$ linear relation

consistent change in distance results in a consistent change in speed.

Exponential Relation

Time (s)	Height (m)
5	10
10	20
15	40
20	80

+5 +5 +5

+10 +20 +40

×2 ×2 ×2

$\boxed{\text{NO}}$ would NOT graph as a straight line

Consistent change in time results in different changes in height

You can also represent many patterns using an **equation**.

A linear relation results in an equation of the form $y = ax + b$, where:

- x and y are variables

  x is the independent variable

  y is the dependent variable

- a and b are numbers

  value of y when $x = 0$

  the constant term, b, represents the starting value

  the coefficient, a, represents the consistent change

  $\text{rate of change} = \dfrac{\text{change in } y}{\text{change in } x}$

Examples

Complete each table of values. Then, write an equation that represents the pattern.

a)

x	y
0	7
5	27
10	47
15	67
20	87
25	107

+5 +5 +5 +5

+20 +20 +20

starting value (b): 7

rate of change (a): $\frac{20}{5} = 4$

equation: $\boxed{y = 4x + 7}$

Check if $x = 10$

$y = 4(10) + 7$
$= 47$ ✓

b)

-3 +3 +3 +3

g	0	3	6	9	12	15	18
h	20	170	320	470	620	770	920

-150 +150 +150 +150

starting value (b): 20

rate of change (a): $\frac{150}{3} = 50$

equation: $y = ax + b$

$\boxed{h = 50g + 20}$

check:
if $g = 9$
$h = 50(9) + 20$
$= 450 + 20$
$= 470$

Discrete quantities can be counted.

- Examples: number of triangles, number of people
- A relationship is described as discrete if there is a limited number of values between two points.

Continuous quantities can be infinitely divided. (things we measure)

- Examples: time, distance, temperature
- A relationship is continuous if there is an unlimited number of values between two points.

Examples

For each scenario, identify the constant term and the numerical coefficient that would be used in an equation. State whether the relationship is discrete or continuous.

a) A plane is flying at an initial height of 8000 m.
It descends for landing at a rate of 50 m/s.

distance
time

constant (b): 8000

discrete OR continuous

numerical coefficient (a): −50
"rate of change"

height $\boxed{H = 8000 - 50t}$ time
$y = b + ax$

b) To produce the PGSS yearbook, the publishing company charges an $900 set-up fee plus $13.65 per book printed.

constant (b): 900

discrete OR continuous

numerical coefficient (a): 13.65

number of books *
total cost

(ordering parts of books doesn't make sense).

$\boxed{C = 900 + 13.65n}$
$y = b + ax$

total cost

number of books.

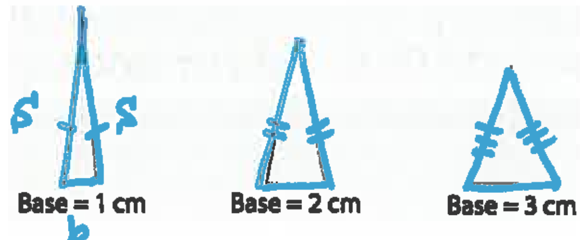
Develop Understanding

Example: Describe a Measurement Pattern Using a Linear Equation

Three isosceles triangles each have a perimeter of 25 cm, but their side measurements are different.

Remember, $\boxed{P = b + 2s.}$

$$s = \frac{P-b}{2}$$



a) Make a table of values to show the relationship between the lengths of the equal sides of the triangle and the base.

b) Describe the pattern in words.

c) Develop an equation to determine the side length in relation to the base of the triangle.

d) What is the side length if the base is 6.2 cm?

0 12.5

a)

Base Length b	Side Length s	Pattern Used to Calculate Length
1	12	$(25-1)\div 2$
2	11.5	$(25-2)\div 2$
3	11	$(25-3)\div 2$

+1 +1 −0.5 −0.5

b) we started with the perimeter, the subtracted the base length, then divided by two

c) $\boxed{s = \frac{25-b}{2}}$ OR $\boxed{s = -0.5b + 12.5}$

$y = ax + b$ $b = 12.5$ $a = \frac{-0.5}{1} = -0.5$

$s = 12.5 - \frac{b}{2}$

$s = 12.5 - 0.5b$

d) $s = \frac{25-6.2}{2}$

$= \frac{18.8}{2}$

$= \boxed{9.4\text{cm}}$

Not Done

Example: Describe a Written Pattern Using a Linear Equation

Jason signed up for a loyalty program at Fair Trader Bubble Tea. He starts with 100 bonus points and gets $\frac{1}{2}$ of the value of his purchases in points.

a) Construct a table of values showing the changing value, in $20 intervals, of Jason's loyalty account as he buys more tea. Add a column to show the pattern of the changing value.

b) Describe the pattern in the changing value of the account.

c) Is this a discrete or continuous relationship? Explain.

d) Write an equation that represents the current number of points in Jason's account.

e) How do the values of the constant term and the numerical coefficient relate to the loyalty plan?

f) How many points will Jason have in his account after he spends $525?

Tea Purchased ($) p	**Loyalty Points** L	**Pattern related to Loyalty Points**
	100	
	110	
	120	
	130	
	140	
	150	

Key ideas

- You can use a table of values to summarize many patterns.
- You can represent many patterns using an equation that relates two or more quantities.
- The terms of an equation have meaning. In $y = ax + b$,
  - the constant term b represents an initial, or starting, value
  - the numerical coefficient a represents the constant change in value