P2

Math 9
5.1 Representing Patterns – part 2

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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

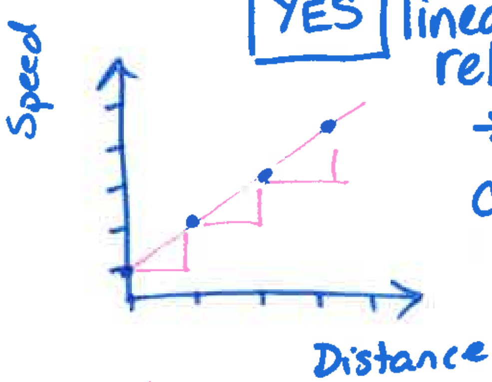
Determine if each table of values represents a linear relation. How do you know?

+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.



would graph as a straight line.

Exponential Relation

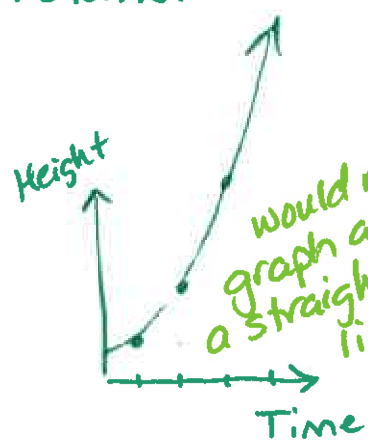
Time (s)	Height (m)
5	10
10	20
15	40
20	80

+5 +5 +5

+10 +20 +40

×2 ×2 ×2

$\boxed{\text{NO}}$ not a linear relation



would not graph as a straight line

Consistent change in time results in <u>different</u> 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 rate of change

  $\frac{\text{change in } y}{\text{change in } x}$ (how y changes every time x goes up by 1)

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 +5

+20 +20 +20 +20 +20

starting value (b): 7

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

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

b)

-3 +3 +3 +3

x g	0	3	6	9	12	15	18
y 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: $y = ax + b$

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

Discrete quantities can be counted.

- Examples: number of triangles, number of students
- 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

starting point (b) rate of change (a)

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.

$y = ax + b$

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

constant (b): 8000

numerical coefficient (a): −50

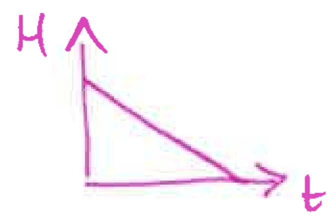
discrete OR continuous

distance and time are things we measure

$H = 8000 - 50t$

$$\boxed{H = -50t + 8000}$$

height time



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

ordering "parts of books" doesn't make sense

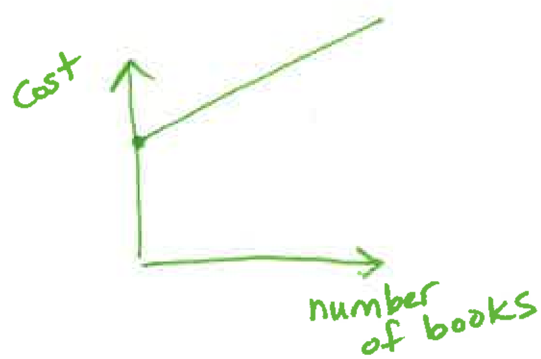
constant (b): 900

numerical coefficient (a): 13.65

discrete OR continuous

$$\boxed{C = 13.65n + 900}$$

total cost number of books

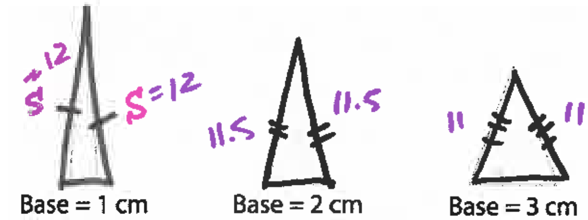


two sides the same length

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, $P = b + 2s$.



a) Make a table of values to show the relationship between the lengths of the equal sides of the triangle and the base. 12.5 ← b

Perimeter
base

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) Describe the pattern in words.

we started with the perimeter, then we subtracted the base length, the we divided what was left by two (to "split" it between the two equal sides)

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

$$\boxed{s = \frac{25-b}{2}}$$

$$s = \frac{25}{2} - \frac{b}{2}$$

$$s = 12.5 - 0.5b$$

$y = ax + b$ $\quad b = 12.5$

$a = \frac{-0.5}{1} = -0.5$

$$\boxed{s = -0.5b + 12.5}$$

continuous relation.

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

$$s = \frac{25-6.2}{2}$$
$$= 9.4\text{ cm}$$

OR

$$s = -0.5(6.2) + 12.5$$
$$= -3.1 + 12.5$$
$$= 9.4\text{ cm}.$$