Section 5.6 Properties of Linear Relations

When a relation is represented using a graph, there are four methods to check if the relation is linear or non-linear.

1. Table of Values
2. Ordered Pairs
3. Graph
4. Equation

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1. Table of Values

- When there is a **constant change** in both the independent and the dependent variables the relationship is **linear**.

p	C
0	15
1	23
2	31
3	39
4	47

2. Ordered Pairs

- Follow the same rule as the table of values.
- A **constant change** in both variables means the relationship is **linear**.

$(0,15)$

$(1, 23)$

$(2,31)$

$(3, 39)$

$(4, 47)$

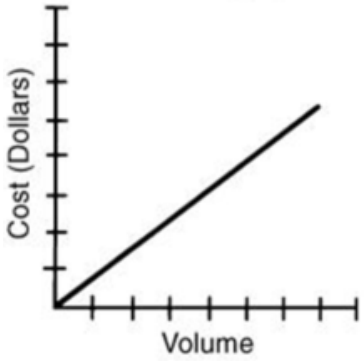
Note:
If there is not a constant change in both variables, the relation is non-linear.

3. Graph

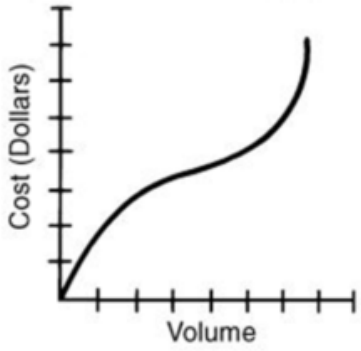
- When the relation has a straight line graph it is linear.

Question 1: Determine whether the following graphs are linear or nonlinear.

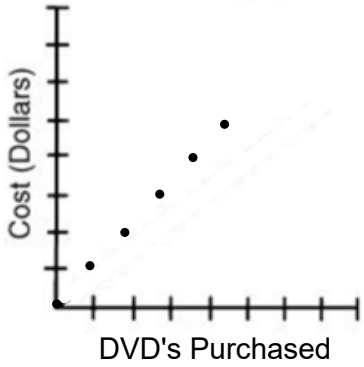
a)



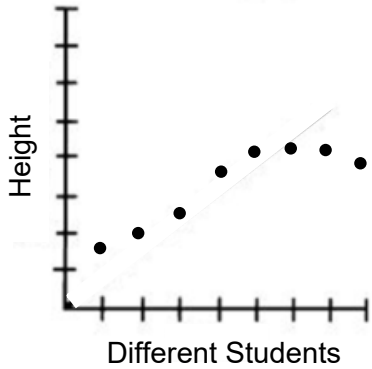
b)



c)



d)



Note: A relation can be linear and discrete OR linear and continuous.

4. Equation

- A relation is linear if the greatest exponent on each variable is 1.
- In other words, the degree of the equation is 1.

Question 2: Which equations are linear?

a) $C = 5p + 120$ b) $y = -3x + 8$ c) $y = x^2 + 4x + 4$

Example 1

Determine whether each table of values represents a linear relation.

a) The relation between temperature in degrees Celsius, C, and the temperature in degrees Fahrenheit, F.

C	F
0	32
5	41
10	50
15	59
20	68

b) The relation between the current, I amps, and power, P watts, in an electrical circuit.

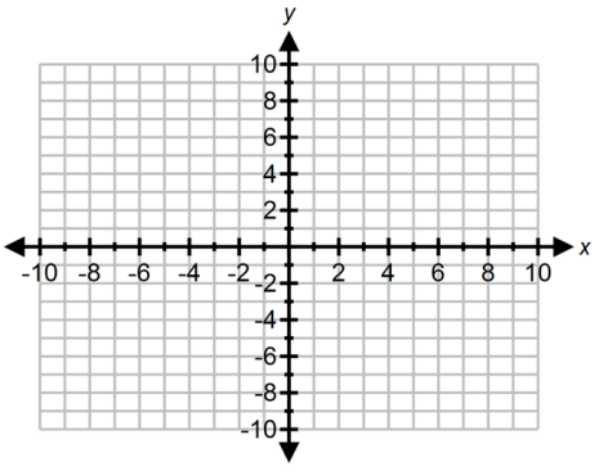
I	P
0	0
5	75
10	300
15	675
20	1200

Example 2

Complete each table of values and sketch the graph. Is each relation linear or nonlinear? Explain.

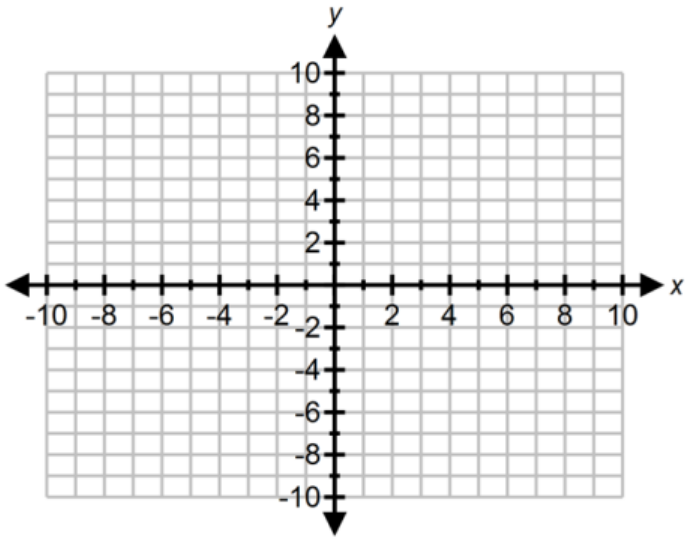
a) $y = -3x + 2$

x	y



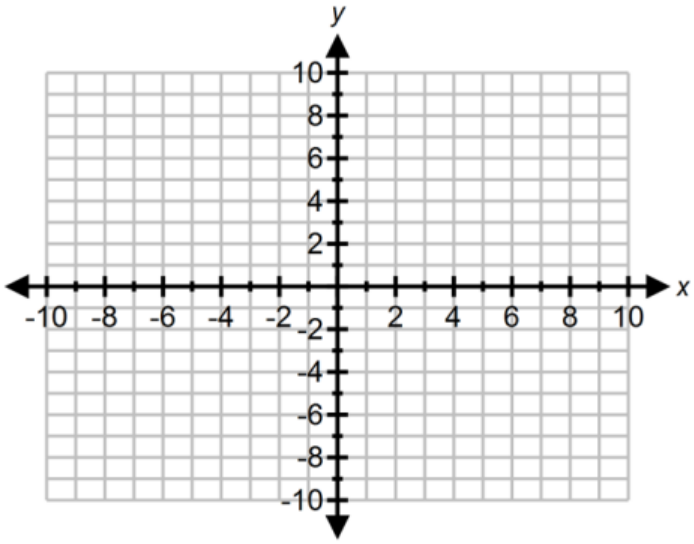
b) $y = 2x^2 + 1$

x	y



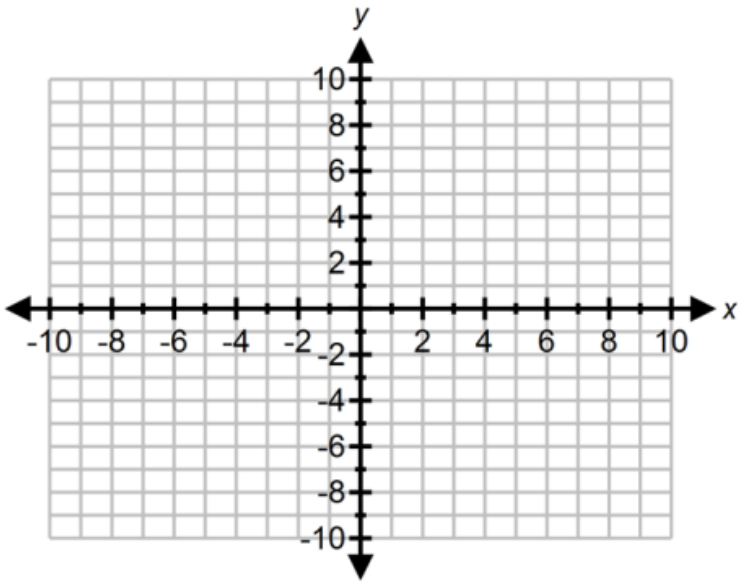
c) $y = 5$

x	y



d) $x = 1$

x	y



Did you notice?

- ✓ the exponent was 1 for each variable for linear relations.
- ✓ both variables had a constant change in the table of values for linear relations.
- ✓ straight line graphs for linear relations.

Work Book Questions	Extra Practice Questions
p.308 - 309 #3bd, 4abc, 5acd, 6b, 8	p.308 #3ac, 5b

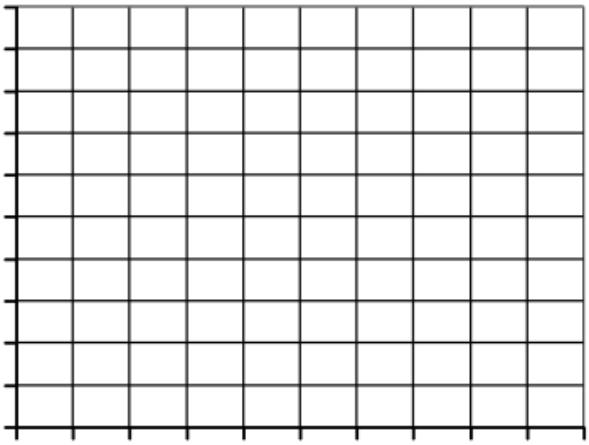
Example 3 The cost for a rental car is $60, plus $20 for every 100 km driven.

a) What are the independent and dependent variables?

b) Complete the table of values.

Distance (km)	Cost ($)
0	
100	
200	
300	
400	

c) Sketch the graph.



Did you remember to .....

- ✓ title the graph?
- ✓ label the x and y axis?
- ✓ increase by a constant amount on each axis?
- ✓ determine if the relation was discrete or continuous?

d) Refer to the graph.

↳ Describe the change in the dependent variable.

↳ Describe the change in the independent variable.

These numbers can be written as a fraction and is very useful information for linear relations. It's called .....

Rate of Change of a Linear Relation

$$\text{rate of change} = \frac{\text{change in dependent variable}}{\text{change in independent variable}}$$

e) What is the rate of change for this relation?

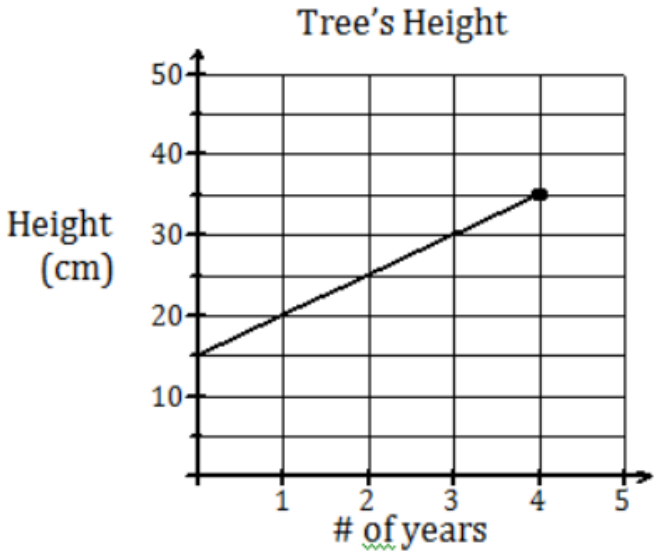
f) Write an equation for this relation?

★

Example 4

Refer to the table of values and the graph below, where **H** represents the height of a tree in centimeters and ***y*** represents the age of the tree in years.

y	H
0	15
1	20
2	25
3	30
4	35



a) Is this a linear relation? Explain.

b) Determine the rate of change and explain what it represents.

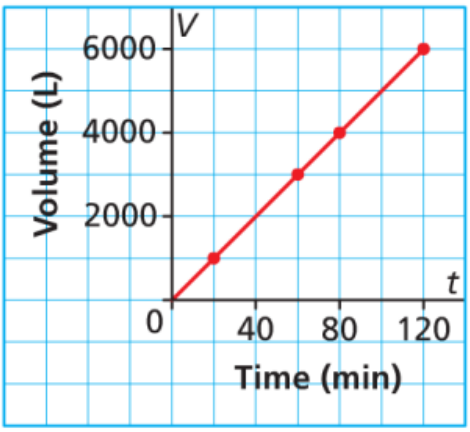
c) Write the equation of the relation.

Example 5

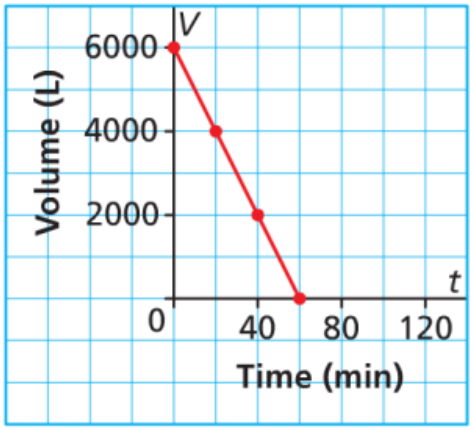
A water tank on a farm near Swift Current, Saskatchewan, holds 6000L.

- Graph A represents the tank being filled at a constant rate
- Graph B represents the tank being emptied at a constant rate

Graph A
Filling a Water Tank



Graph B
Emptying a Water Tank



a) Identify the independent and dependent variables.

b) Determine the rate of change for each graph and explain what it represents.

Work Book Questions	Extra Practice Questions
p.309 - 310 #12ab, 14ab, 16abc	p.309 - 310 #13, 17ab