Lesson 6 Function Notation

November 14, 2018 3:52 PM

6) RELATIONS & FUNCTIONS: FUNCTION NOTATION

$y = mx + b$ or $y = mx + c$ is ALWAYS a line

Warm-Up #1: Complete the table of values for the equation $y = 3x + 2$

$y = 3(-3) + 2 = -7$

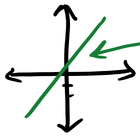
$y = 3(-1) + 2 = -1$

$y = 3(0) + 2 = 2$

x	y
−3	−7
−1	−1
0	2
1	5
3	11

$y = 3(1) + 2 = 5$

$y = 3(3) + 2 = 11$



y-intercept at y = 2.

Does this equation represent a function? YES

Warm-Up #2: Evaluate $y = 2x^2 - 3x + 5$ for each of the given values.

a) $x = -3$

$y = 2(-3)^2 - 3(-3) + 5$

$y = 2(9) + 9 + 5$

$y = 32$

b) $x = 3$

$y = 2(3)^2 - 3(3) + 5$

$y = 2(9) - 9 + 5$

$y = 14$

Warm- Up #3: Evaluate $y = 3x - 5$ for each of the given values.

a) $y = 10$

$(10) = 3x - 5$ (+5, +5)

$15 = 3x$ (÷3)

$x = 5$

b) $y = -26$

$(-26) = 3x - 5$ (+5, +5)

$-21 = 3x$ (÷3)

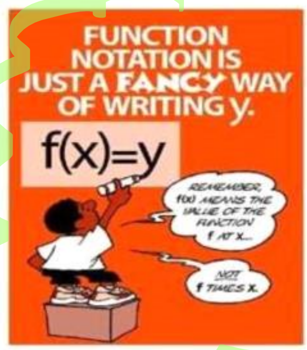
$x = -7$

Functions can be written using function notation.
For example, $y = 3x + 2$ can be written as $f(x) = 3x + 2$

y = ? we have to decide IF it is a function → VLT

it IS a function

$f(x)$ is read as "f of x"



treat like 'y'

Investigation: If $f(x) = 3x + 2$ determine the following.

x =

a) $f(-3) = 3x + 2 = 3(-3) + 2 = -9 + 2 = -7$

b) $f(-1) = 3x + 2 = 3(-1) + 2 = -3 + 2 = -1$

c) Predict the value of $f(0)$, $f(3)$.

"solve"

$f(0) = 3x + 2 = 3(0) + 2 = 0 + 2 = 2$

$f(3) = 3x + 2 = 3(3) + 2 = 9 + 2 = 11$

function notation; we know this is a function.

Example #1: If $p(a) = -2a + 5$, determine the following:

a) $p(-2)$ — x-value (a)

$p(-2) = -2a + 5$
$= -2(-2) + 5$
$= 4 + 5$
$p(-2) = 9$ ⟹ when $x = -2$, $y = 9$

b) $p(1) = -2(1) + 5$
$= -2 + 5$
$p(1) = 3$ — when $x = 1$, $y = 3$

c) a, if $p(a) = 1$ — solving for a

$p(a) = -2a + 5$
$1 = -2a + 5$
$-5 \quad -5$
$-4 = -2a$
$\div -2 \quad \div -2$
$a = 2$ ⟹ when $x = 2$, $y = 1$

d) a, if $p(a) = -5$

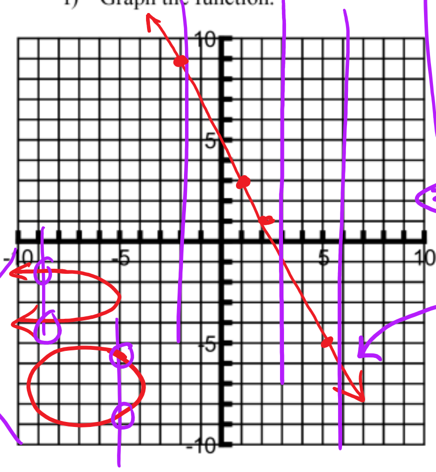
$-5 = -2a + 5$
$-5 \quad -5$
$-10 = -2a$
$\div -2 \quad \div -2$
$a = 5$ ⟹ when $x = 5$, $y = -5$

e) Use your results to create a table of values. "a" "p(a)"

all x-values are 'a'

x	y
-2	9
1	3
2	1
5	-5

f) Graph the function.



g) Is this discrete or continuous data? Explain.

it is a line ⟹ (Linear Function) ∴ points ON and between plotted values are "true"

Example #2: If $g(x) = 5x - 1$, determine a simplified expression for each of the following:

a) $g(2x)$ = $5x - 1$
$g(2x) = 5(2x) - 1$
"y" $= 10x - 1$
$g(2x) = 10x - 1$

b) $g(x - 5)$ = $5(x) - 1$
$g(x-5) = 5(x - 5) - 1$
"y" $= 5x - 25 - 1$
$g(x-5) = 5x - 26$

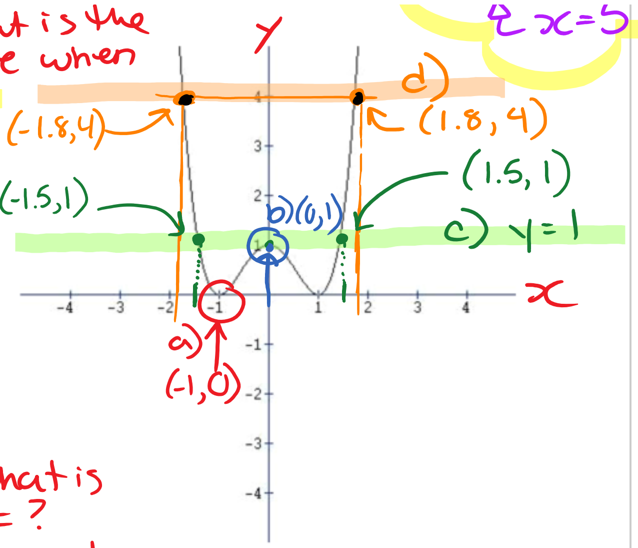
*Treat f(x) as "y" *

$f(x) = 2$ "y = 2"
$f(5)$ ⟹ $x = 5$

Example #3: Use the graph below to determine the values.

a) $f(-1)$ — asking: what is the y-value when $x = -1$

Example #3: Use the graph below to determine the values.



a) $f\ (-1)$ ← asking: what is the y-value when $x=-1$

$f(-1)=0$

b) $f\ (0)$ when $x=0$, $y=?=1$

$f(0)=1$

c) x when $f\ (x\ )=1$ ← asking: what is $x=?$ when $y=1$

$x=-1.5, 0, 1.5$

d) x when $f\ (x\ )=4$ what is $x=?$ when $y=4$

$x=-1.8, 1.8$ $(-2, 2)$

NOTE IS THIS A FUNCTION?

YES!
- passes the VLT
- there is only 1 y-value for every x-value
- (there are multiple x-values for some y-values ⇒ allowed)

Homework

ASSIGNMENT # 6
pages 30-35 & 38 Questions #110-160 +169-170
pg's 36, 37 & 41 (optional extra practice)

Function Notation:

There is a special way to write functions. This is called function notation.

Consider the following comparisons:

Equation	Function Notation
$y = x + 2$	$f(x) = x + 2$
$y = 3x - 5$	$f(x) = 3x - 5$
$C = 20t + 1200$	$C(t) = 20t + 1200$
$G = 3h^2 - 2$	$g(h) = 3h^2 - 2$

Notice the *f(x)* part simply replaces the *y*. There is no new operation; it is only a new way of writing the equation. It immediately tells you "this is a function."
Notice the letter in brackets is always the same as the one on the right.

- Function notation allows us to use letters appropriate to our function and differentiate between several functions (give them unique names).
- Also the notation tells us which variable is **dependent** on the other.

Eg. $g(h) = 3h^2 - 2$ tells us that function g is written in terms of h. That is, *g depends on h.*

Function notation can also be used to tell us to perform an operation.

Evaluate $f(2), f(-3), f(x+2)$ for the function $f(x) = 3x + 7$

$f(2) = 3(2) + 7$

$f(2) = 13$

$f(-3) = 3(-3) + 7$

$f(-3) = -2$

$f(x+2) = 3(x+2) + 7$

$f(x+2) = 3x + 6 + 7$

$f(x+2) = 3x + 13$

If $f(x) = 5x - 6$, find

110. $f(4)$

111. $f(-1)$

112. $f(-3+x)$

If $g(x) = 2x - 4$, find

113. $g(4)$

114. $g(-1)$

115. $g(x-1)$

If $h(x) = 5x^2 - 6$, find

116. $h(4)$

117. $h(-1)$

118. $h(x+1)$

$h(x + 1) = 5(x + 1)^2 - 6$
$= 5(x + 1)(x + 1) - 6$ distributive property
$= 5(x^2 + 1x + 1x + 1) - 6$ collect like-terms
$= 5(x^2 + 2x + 1) - 6$ distributive property
$= 5x^2 + 10x + 5 - 6$ collect like-terms
$= 5x^2 + 10x - 1$

If $q(x) = x^2 + 2x + 3$, find

119. $q(4)$

120. $q(x+1)$ **CHALLENGE

121. $q(2x-3)$ **CHALLENGE

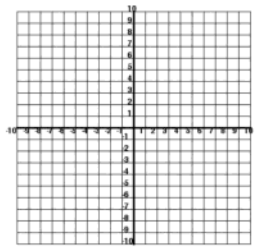
If $g(x) = -2x + 1$, find

122. $g(4)$

123. Which variable is the independent variable?

124. $g(-1)$

125. Graph $g(x)$
Domain: $x \epsilon R$



**Use your graph in Q125 to check answers for Q122 and Q124.

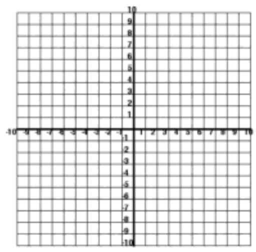
If $f(x) = 2x^2$, find

126. $f(4)$

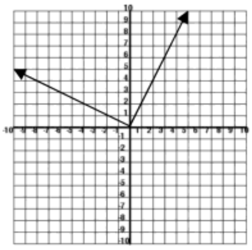
127. Which variable is the dependent variable?

128. $f(-1)$

129. Graph $f(x)$ if the Domain: $x \epsilon R$



Use the graph of *h(t)* to answer the following questions.

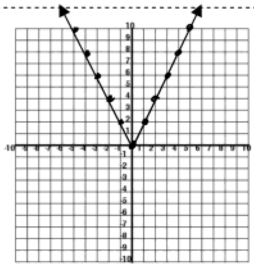


130. Find $h(2)$.

131. Find $h(-6)$.

132. $h(t) = 4$
Find both values of t.

Use the graph of *d(x)* to answer the following questions.

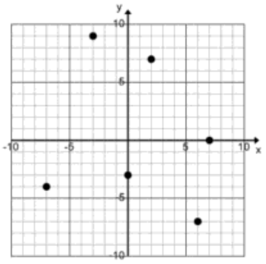


133. Find $d(-3)$.

134. Find $d(5)$.

135. $d(x) = 2$
Find both values of x.

Use the graph of $f(x)$ to answer the following questions.



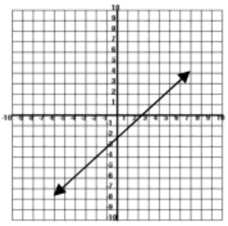
136. Find $f(-3)$.

137. Find $f(5)$.

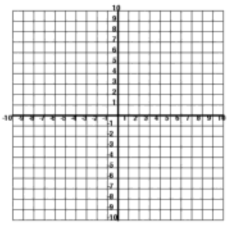
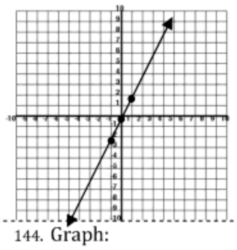
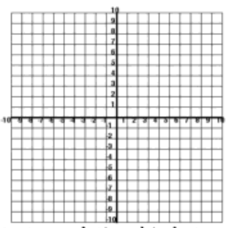
138. Find x if $f(x) = 0$.

Describing the same relation in various ways.

Below are three descriptions of the same relation.

Equation:	Graph:	Words:
$f(x) = x - 2$ Or $y = x - 2$		Each element in the range is two less than the element in the domain.

Fill in remaining two cells below for the given relation.

Equation: **GIVEN THE FUNCTION…** $f(x) = 3x - 1$	139. Graph: 	140. Words:
141. Equation:	**GIVEN THE FUNCTION…** 	142. Words:
143. Equation:	144. Graph: 	Words: **GIVEN THE FUNCTION…** Each element of the range is equivalent to the square of an element in the domain.

The following two examples demonstrate a relationship between two quantities.

A computer service technician charges a fee of \$120 to assess a problem and a fee of \$60 per hour to fix the problem. If the high school network requires 12 hours of work, what will the total cost be?

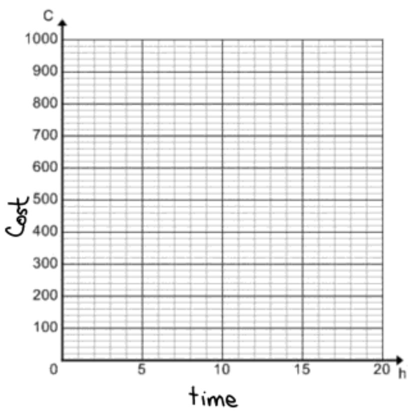
Cost:
$= \$120 + 12(\$60)$
$= \$120 + \$720$
$= \$840$

This is a relationship between **time worked** and **cost.**

We could show this as $(12, 840)$.

145. Create a set of data for the relation above.

146. Graph the data you created in the question above.



The height of a thrown object can be modeled as a function of time (since it was thrown) by the following equation.

$$h(t) = -5t^2 + 12.5t + 100$$

Find the height of the object 2 seconds after it has been thrown.

Height is found by *substituting* 2 into the right side of the equation.

$h(2) = -5(2)^2 + 12.5(2) + 100$
$h(2) = -20 + 25 + 100$
$h(2) = 105\ m$

This is a relationship between height and time.

We could show this as $(2, 105)$.

147. Create a set of data for the relation above.

148. Graph the data you created in the question above.

Solve each problem using any strategy that works.

A computer service technician charges a fee of $120 to assess a problem and a fee of $60 per hour to fix the problem.

149. If the high school network requires 7 hours of work, what will the total cost be?

150. What are the two variables in this problem?

____

____

151. Which variable would be the "dependent variable?" (see pg.30)

____

152. Does the dependent variable correspond to the domain or range?

____

____

153. Do you think this problem models discrete or continuous data? Explain.

____

____

154. What is significant about the point (0,120)?

____

____

The height of a thrown object can be modeled as a function of time since thrown by the following equation.

$$h(t) = -5t^2 + 12.5t + 100$$

155. Find the height of the object 3 seconds after it has been thrown.

156. Can you think of any values for time (t) that don't make sense?

____

157. What does time represent domain or range?

____

158. Can you think of any values for height (h) that don't make sense?

____

159. Is height the dependent or independent variable?

____

160. Use the graph on the previous page to estimate the time it takes the object to reach maximum height.

BONUS: Can you calculate the time it takes the object to land?

Solve each problem using any strategy that works.

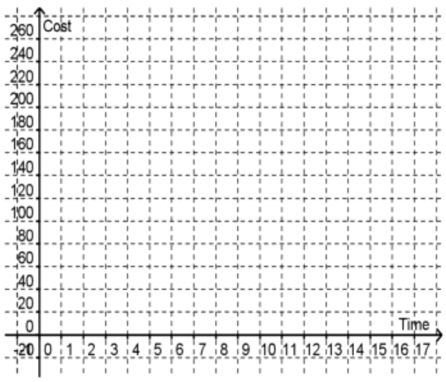
161. A bike technician charges $40 for a basic tune-up and $20/h for any additional work.

Write an equation that relates cost (C) to time (t) for the scenario above.

162. Create a table for the scenario above.

Time (hours)	Cost ($)

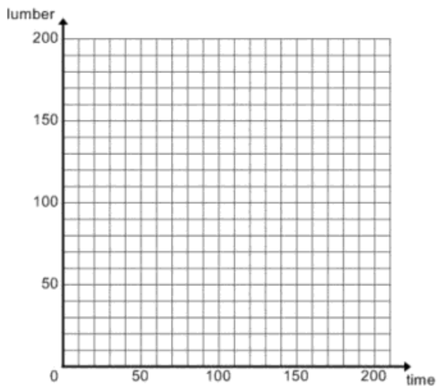
163. Graph the relation above.



164. The population of a colony of bacteria grows through cell division. The doubling time for the population is 30 minutes. Complete the table below for the growth of bacteria <u>starting with one bacterium</u>.

Time (minutes)	Number of Bacteria
0	
30	
60	
90	
120	
210	

165. Graph the relation above.



166. What numbers are acceptable values for the horizontal axis (domain) of the graph above? (Think about what numbers would not make sense.)

167. Going to the movies. The cost of going to the movies for a group of grade 10 students is represented by the equation $C = 10.5n$.

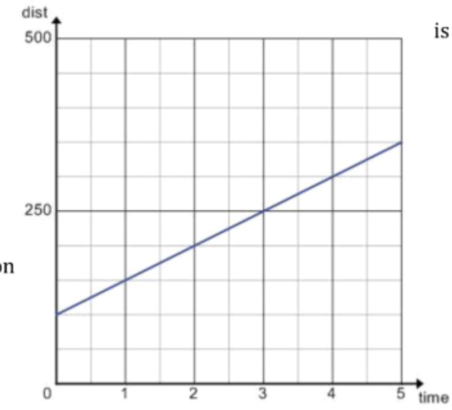
a) What is a reasonable range for this function?

b) What is the dependent variable?

c) Write the equation using function notation.

168. Driving Distance. JJ leaves Nanaimo driving north. At the time he left, he was 105 km from home. The following graph represents the relationship between distance from home and elapsed driving time.

The equation for the relation is $d(t) = 50t + 100$.



a) Explain why the function is called $d(t)$.

b) Suggest a reasonable domain for the function $d(t)$.

c) Find $d(3)$.

d) Why is the graph a line and not a series of dots?

169. Halloween dance. Student's Council plans on hiring DJ-Jae-Sun for this year's Halloween dance. Jae-Sun appreciates what he remembers of math functions and sends the council the following pricing information.

$$C(n) = 2000 + 17.50n$$

a) Explain what you think the equation above means.

b) What would be a reasonable domain at your school?

c) What is a reasonable range for your school?

d) What does the range represent?

e) Is this the dependent or independent variable?

170. Wedding banquet. Lin-Karen is planning her dream wedding. Catering costs are a function of the number of people that attend the wedding. A high end caterer quoted Lin-Karen a set-up cost of 1500 dollars plus 75 dollars per guest.

a) Write the cost as a function of the number of guests using function notation.

b) Is this **Discrete** or **Continuous** data?

c) Graph the relation above using a reasonable domain. Use a ruler to mark your axes. Label your axes with "Number of Guests" on the horizontal axis.

177. A hot cup of coffee was left on the table to cool. <u>Graph</u> the data below.

Time (min)	0	2	4	6	8	10	12	14

178. To hire a plumber to fix his drain, Mr. J had to pay an initial "call-out" fee of $60 then he had to pay the plumber $45 per hour. Graph the Cost as a function of Time in hours for this service.

177. A hot cup of coffee was left on the table to cool. Graph the data below.

Time (min)	0	2	4	6	8	10	12	14
Temp. (°C)	84	60	44	34	26	23	21	21

178. To hire a plumber to fix his drain, Mr. J had to pay an initial "call-out" fee of $60 then he had to pay the plumber $45 per hour. Graph the Cost as a function of Time in hours for this service.