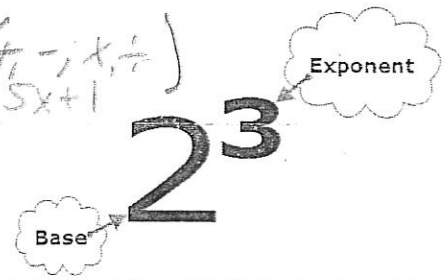
1.1 Variables and Expressions

- Algebraic Expression – consists of operations (+, −, ×, ÷) of #s + variables $10x$ $x+3$ $5x+1$
- Term – #, variable or product #s & var. 2, x 3x
- Power – x^n



Operation	Key Words
Addition	more, sum, plus, increased
Subtraction	less, subtracted, difference, decreased
Multiplication	product, mult, times, of
Division	quotient, divided by

Example

Write a verbal expression for each algebraic expression.

$8x^2$ eight times x squared

$y^5 - 16y$ the diff of y to 5th power & 16 times y

$\frac{2}{3}r^4$ two-thirds times r to the 4th power

$a^2 - 18b$ a squared minus 18 times b

Example

Write an algebraic expression for each verbal expression.

5 *less than a number c* $c - 5$

9 *plus the product of* 2 *and d* $9 + 2d$

two fifths of the area a $\frac{2}{5}a$ or $\frac{2a}{5}$

Example

Mr. Nehu bought two adult tickets and three student tickets for the planetarium show. Write an algebraic expression that represents the cost of the tickets. $2a + 3s$

Example

Johnny bought a bag of peanuts for p dollars and gave the cashier a $20 bill. Write an expression for the amount of change that Johnny will get back. $20 - p$

1.2 Order of Operations

- Order of Operations

P ( ) [ ]
E 3^2
M D
A S

Same level, do what come to 1st

$5+(8+[7-2])$
$5+(8+5)$
$5+13=18$

Example – Evaluate the following.

2^6

64

$[(6^3-9)\div 23]4$

$(207\div 23)4$
$9\cdot 4$
36

$48\div 2^3\cdot 3+5$

23

$3x-7y$ when $x=4$ and $y=5$

4 5
$12-35$
-23

$\frac{(4\cdot 3)^2}{9+3}$

$\frac{(12)^2}{12}$
12

$\frac{b(9-c)}{a^2}$ *when* $a=4, b=6, and\ c=8$

$\frac{6(9-8)}{4^2}$ $\frac{6\cdot 1}{16}$

$\frac{3}{8}$

Example

Each side of the Great Pyramid of Giza, Egypt, is a triangle. The base of each triangle once measured 230 meters. The height of each triangle is one-half the product of the base b and its height h.

a) Write an expression that represents the area of one side of the Great Pyramid.

$\frac{1}{2}(bh)$

b) Find the area of one side of the Great Pyramid.

$\frac{1}{2}(230\cdot 187)$ $21{,}505m^2$

Examples – No Calculator

$9^2 - 2$

$81 - 2 = 79$

$\frac{11-8}{1+7\cdot 2}$

$\frac{3}{15} = \frac{1}{5}$

$8x - 2y \text{ when } x = 2 \text{ and } y = 1$

$16 - 2$

14

$5 \cdot 5 - 1 \cdot 3$

$25 - 3$

22

$\frac{(4\cdot 3)^2}{9+3}$

$\frac{144}{12}$

12

$x^2 - xy \text{ when } x = 3 \text{ and } y = 4$

$9 - 3 \cdot 4$

-3

Example

ERROR ANALYSIS Tara and Curtis are simplifying $[4(10) - 3^2] + 6(4)$. Is either of them correct? Explain your reasoning.

Tara	Curtis
$[4(10) - 3^2] + 6(4)$	$[4(10) - 3^2] + 6(4)$
$= [4(10) - 9] + 6(4)$	$= [4(10) - 9] + 6(4)$
$= 4(1) + 6(4)$	$= (40 - 9) + 6(4)$
$= 4 + 6(4)$	$= 31 + 6(4)$
$= 4 + 24$	$= 31 + 24$
$= 28$	$= 55$

Curtis is correct

Tara subtracted By multiplying

1.3 Properties of Numbers

Property	Description	Example
Reflexive "Reflective"	Any quantity is equal to itself.	$8=8$ $x=x$
Symmetric	If one quantity equals a second quantity, then the second quantity equals the first.	$a=b$ then $b=a$ $8+2=10$ then $10=8+2$
Transitive	If one quantity equals a second quantity and the second quantity equals a third quantity, then the first quantity equals the third quantity.	If $x=2$ and $2=y$, then $x=y$
Substitution	A quantity may be substituted for its equal in any expression.	If $x=3$, then $4x=4\cdot 3$
Additive Identity	For any number a, the sum of a and 0 is a.	$a+0=a$
Additive Inv.	A number and its opposite are additive inverses of each other.	$a+-a=0$
Mult. Identity	For any number a, the product of a and 1 is a.	$3\cdot 1=3$
Mult Prop of Zero	For any number a, the product of a and 0 is 0.	$3\cdot 0=0$
Mult. Recip.	For every number $\frac{a}{b}$, where $a, b \neq 0$, there is exactly one number $\frac{b}{a}$ such that the product of $\frac{a}{b}$ and $\frac{b}{a}$ is 1.	$3\cdot\frac{1}{3}=1$

Example – No Calc

Evaluate and name the property used in each step.

$\frac{1}{4}(12-8)+3(15\div 5-2)$

Versatiles

$\frac{1}{4}(4)+3(15\div 5-2)$ Sub.

$\frac{1}{4}(4)+3(3-2)$ Sub

mult Inv.

$1+3\cdot 1$ Sub

$1+3$ mult Ident.

4 Sub.

Example

Maggie made a list of trail lengths to find the total miles she rode. Find the total miles she rode her horse.

Trails	
Name	**Miles**
Bent Tree	4.25
Knob Hill	6.5
Meadowrun	9
Pinehurst	7.75

$4.25 + 6 + 9 + 7.75$

27.5 miles

Example – No Calc

$2 \cdot 8 \cdot 5 \cdot 7$

$2 \cdot 40 \cdot 7$

$2 \cdot 280$

560

$3 \cdot 7 \cdot 10 \cdot 2$

$21 \cdot 20$

420

$(1 \div 5)5 \cdot 14$

$\frac{1}{5} \cdot 5 \cdot 14$

$1 \cdot 14$

14

$\frac{1}{4} \cdot 24 \cdot \frac{2}{3}$

$6 \cdot \frac{2}{3}$

$\frac{12}{3} = 4$

1.4 The Distributive Property

- Distributive Property

4 Groups of 3x+1

$$4(3x + 1)$$

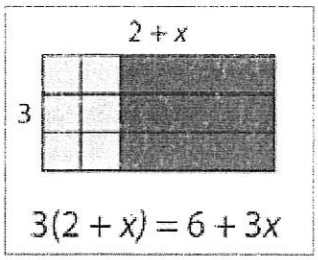
12x + 4

- Like Terms – terms with the same variables raised to the same power

Ex 3x + 4x
2xy + 9yx

Not
3x + 5x²

- Area Model



2(x+4)

2x+8

4(x-2)

4x-8

Example

Julio walks 5 days a week. He walks at a fast rate for 7 minutes and cools down for 2 minutes. Use the Distributive Property to write and evaluate an expression that determines the total number of minutes Julio walks.

5(7+2)
35+10
45

Example

The Ross family recently dined at an Italian restaurant. Each of the four family members ordered an Italian dish that cost $11.50, a drink that cost $1.50, and a dessert that cost $2.75.

a) Write an expression that could be used to calculate the cost of the Ross' dinner before the dinner.

4(11.50+1.50+2.75)

b) What was the family's meal? cost $63

Example

Use the Distributive Property to rewrite 12 * 82. Then evaluate.

(10+2)82
820+164
984

12(80+2)

Example

Rewrite each expression using the Distributive Property. Then simplify.

a) $12(y + 13)$

$12y + 156$

b) $4(y^2 + 8y + 2)$

$4y^2 + 32y + 8$

c) $3(x^2 + 2x - 1)$

$3x^2 + 6x - 3$

d) $-3(x + 7)$

$-3x - 21$

e) $-2(x - 5)$

$-2x + 10$

Example

Simplify the following

$17a + 21a$

$38a$ variable stays same

$12b^2 - 8b^2 + 6b$

$4b^2 + 6b$

$x^2 + 3x - 6x^2$

$-5x^2 + 3x$

$4ab - 2b + 9ab + 7b$

$13ab + 5b$

1.5 Equations

- Open Sentence – alg expression with variable
- Equation – sentence with = as verb

3x+2 Expression
3x+2=7 Eqn.

- Set { 3, 6, 91, ... }

element element element three dots means goes on forever (infinite)

("element" or "member" mean the same thing)

Example
Give three elements of the following sets
{teachers at Bridgman High School}

Mrs. Veldman, Mr. Miller, Mrs. Hurding

{positions on a baseball team}

Pitcher, Catcher, 1st Base

{integers}

1, -3, 10

Example
Find the solution set of the equation 4a + 7 = 23 if the replacement set is {2, 3, 4, 5, 6}.

(2) 4(2)+7=23 X
(3) 4(3)+7=23 X
(4) 4(4)+7=23 ✓
(5) 4(5)+7=27 X
(6) 4(6)+7=31 X

Still use order of operations!

Stop

- Special Situations - Solve

3x+2 = 12	0x – 2 = 14	3x + 9 = 3 (x+3)
3x=10	0x=16	3x+9=3x+9
x= 10/3	No Sol.	0=0
		IR All Real #S

- (1) Situation x=#
- No Solution 5=3 (something that doesn't make sense)
- All Real #S 5=5 x=x (same on both sides)

To Solve Eqns Use Rev. Order of operations

Example

Solve each equation:

$4 + (3^2 + 7) \div n = 8$

$4 + \frac{16}{n} = 8$

$\frac{16}{n} = 4$

$16 = 4n$

$n = 4$

$4n - (12 + 2) = n(6 - 2) - 9$

$4n - 14 = 4n - 9$

$0 = 5$

No Solution

$(5 + 8 \div 4) + 3k = 3(k + 32) - 89$

$7 + 3K = 3K + 96 - 89$

$7 + 3K = 3K + 7$

All real #s

Example

Dalila pays \$16 per month for a gym membership. In addition, she pays \$2 per Pilates class. Write and solve an equation to find the total amount Dalilia spent this month if she took 12 Pilates classes.

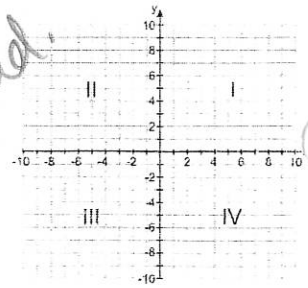
$16 + 2 \cdot 12 = \$40$

Gym Class

$2p + 16$

1.6 Relations

Graph the following points and name the quadrant each is in

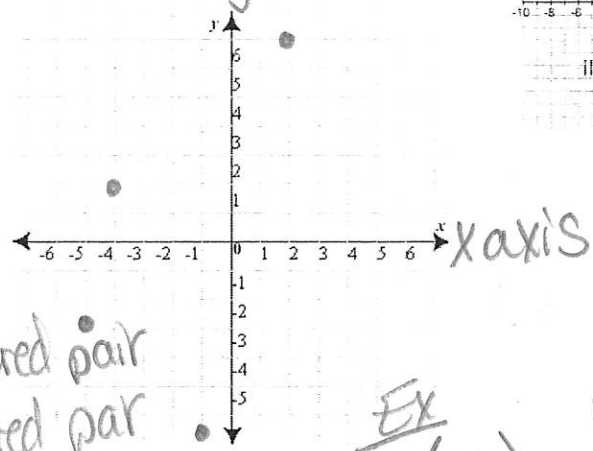


(2, 7) (x, y)

(-4, 2) ↔ ↕

(-5, -3)

(-1, -6)



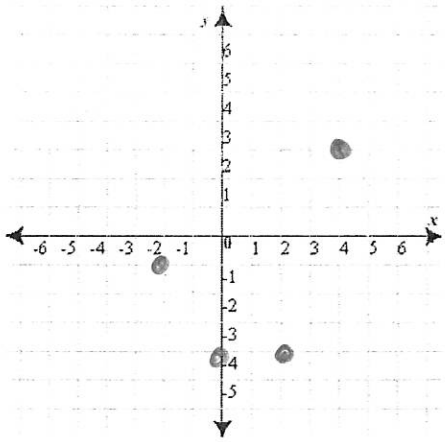
- Domain – first #s in ordered pair
- Range – second #s in ordered pair
- Independent Variable – (x values) domain
- Dependent Variable – (y values) range

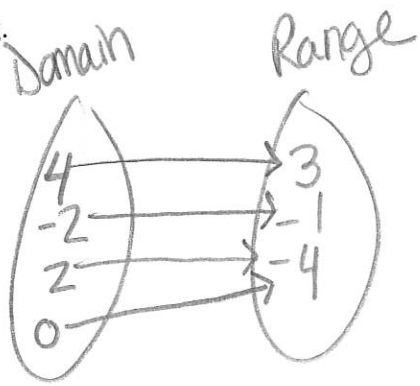
Ex
(1,2)
(3,4)
(5,2)

D 1,3,5
R 2,4

Example
Express {(4, 3), (-2, -1), (2, -4), (0, -4)} as a table, a graph, and a mapping.

X	Y
4	3
-2	-1
2	-4
0	-4





State the domain and range of the relation above.

Domain {4, -2, 2, 0}
Range {3, -1, 4}

- Independent Variable X (Determines the y value)
- Dependent Variable y

Ex
- Tickets sold for homecoming dance.
- Money made on dance by Stud. Senate

Example

Identify the independent and dependent variables for each relation.

a) In warm climates the average amount of electricity used rises as the daily average temperature increases and falls as the daily average temperature decreases.

Indep - temp.
Dep - amt of electricity used

b) The number of calories you burn increases as the number of minutes that you walk increases.

Indep - minutes walked
Dep - calories burned

c) The dance committee is selling tickets to the Fall Ball. The more tickets that they sell, the greater the amount of money they can spend on decorations.

Indep - ticket sold
Dep - $ for dec.

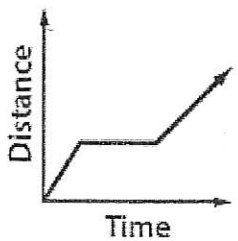
d) A store is having a sale over Labor Day weekend. The more purchases, the greater the profits.

Indep - purchases
Dep - profits

Example

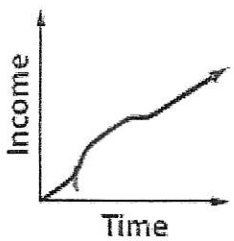
Describe what is happening in each graph.

Bike Ride



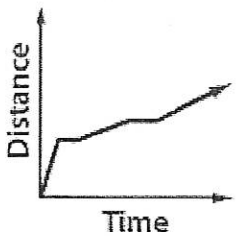
Getting farther away, stopping, continuing getting farther away

Change in Income



Steady increase in income, sharper increase, slight decrease to where started.

Driving to School



Fast rate, stopped, slows down

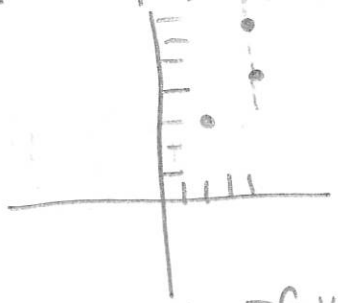
1.7 Functions

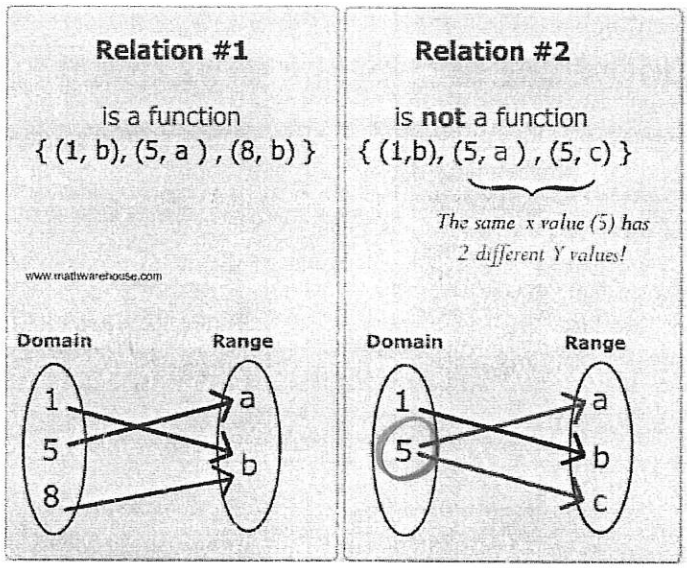
Not all relations are functions!

To be considered a function, there is exactly one output for each input.

Function
(2,3)(4,5)(5,1)

No Function
(2,3)(4,5)(4,7)

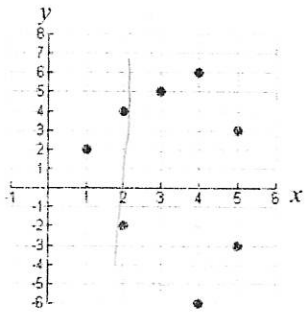




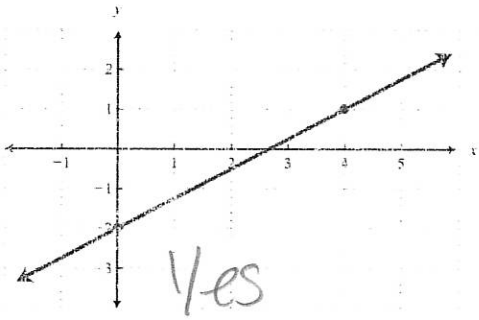
Vert. Line Test = If you can draw a vert line and it hits more than 1 pt, not function

Example

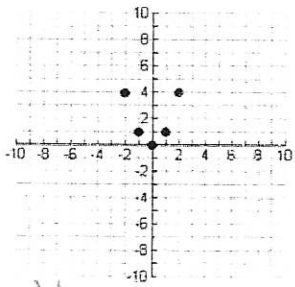
Determine whether each relation is a function, if it is not, explain why not.



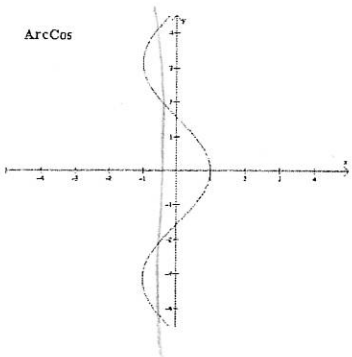
No (2,-2)
(2,4)



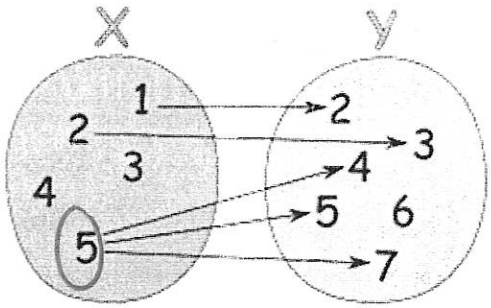
Yes



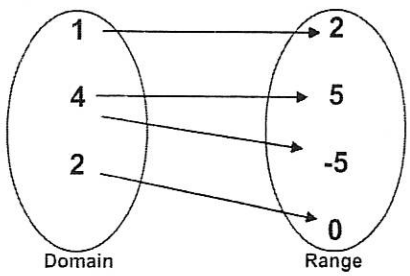
Yes



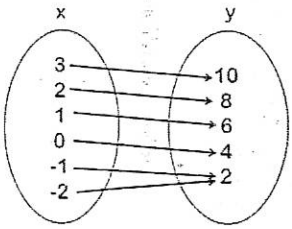
No



No #5 → 4, 5, 7



No 4 → 5 & -5



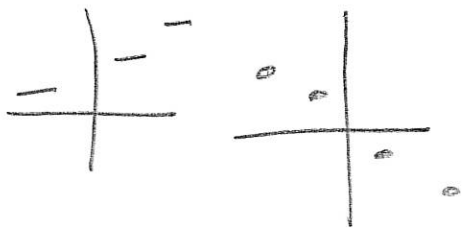
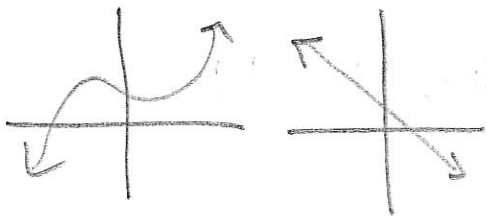
Yes

x	y
-1	-1
0	2
1	5
2	8
3	11

Yes

X	Y
-3	1
-6	2
3	9
-6	4

No -6 → 2, 4

Discrete Functions	Continuous Functions
Not connected pts 	Lines or Smooth Curves (Don't pick up pencil) 

Example

There are three lunch periods at a school. During the first period 352 students eat. During the second period 304 students eat. During the third period 391 students eat.

a) Make a table showing the number of students for each of the three lunch periods.

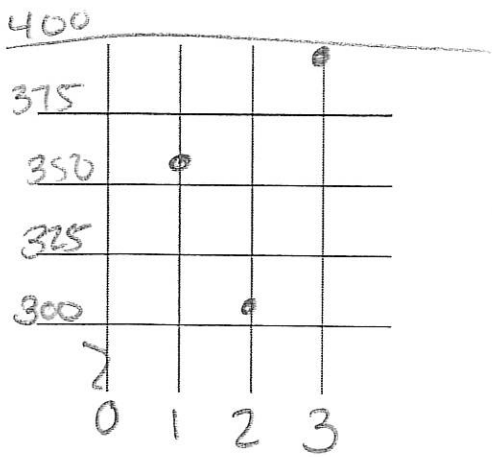
lunch x	1	2	3
students y	352	304	391

b) Domain – 1, 2, 3

c) Range – 352, 304, 391

d) Write the data as a set of ordered pairs, then graph the data.

(1, 352) (3, 391)
(2, 304)



e) State whether the function is discrete or continuous.

Discrete, b/c not connected

- Function Notation

Read "f of x"

$f(x)$ same as y

$f(x) = 3x + 2$ $\quad$ $y = 3x + 2$

<u>Example</u>

For $f(x) = 3x - 4$, *find each value.*

a) f(4) $3(4) - 4 = 8$

b) f(-5) $3(-5) - 4 = -19$

c) f(2) $3(2) - 4$ 2

For $h(t) = 1248 - 160t + 16t^2$ find each value.

a) h(3) $1248 - 160(3) + 16(3)^2$

912

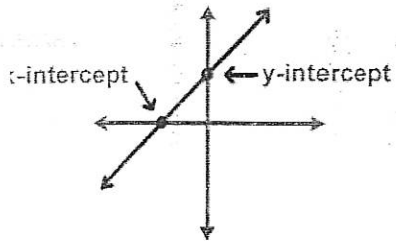
b) h(5) $1248 - 160(5) + 16(5)^2$

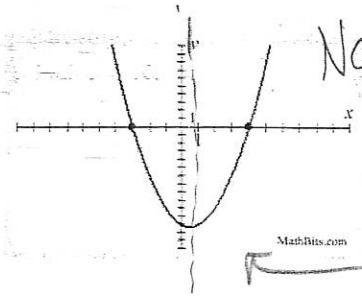
848

c) h(2x) $1248 - 160(2x) + 16(2x)^2$

$1248 - 320x + 64x^2$

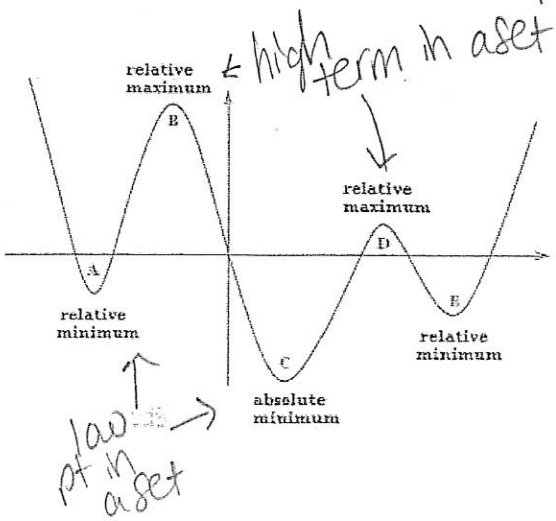
1.8 Interpreting Graphs of Functions

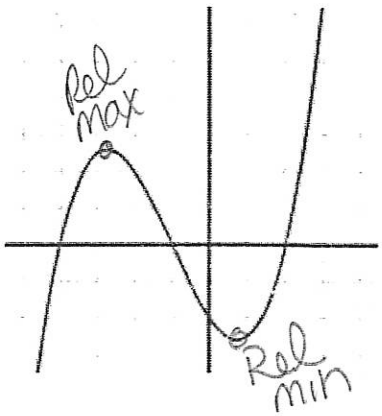




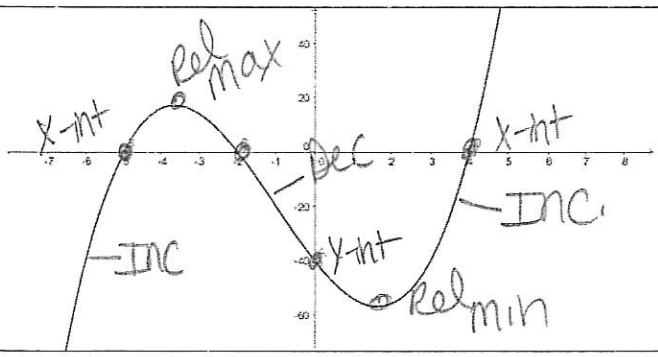
Not Linear

- Linear – equation that makes a line
- Line of Symmetry – where you can fold graph in ½ & both sides =





Try It: Label the following in the graph



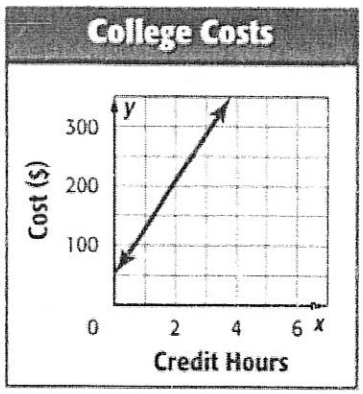
Read graph left to rt

X-Intercepts, Y-Intercept, Relative Maximum, Relative Minimum, Increasing, Decreasing

3 1 1 1

Example

The graph shows the cost at a community college y as a function of the number of credit hours take x. Identify the function as linear or nonlinear. Then estimate and interpret the intercepts of the graph of the function.

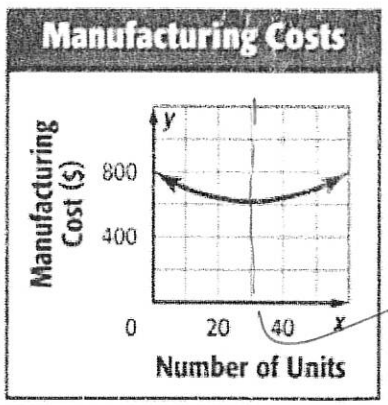


Linear

- No x-int, cost of college never zero
- yint (0,50) $50 processing fee

Example

The graph shows the cost y to manufacture x units of a product. Describe and interpret any symmetry.

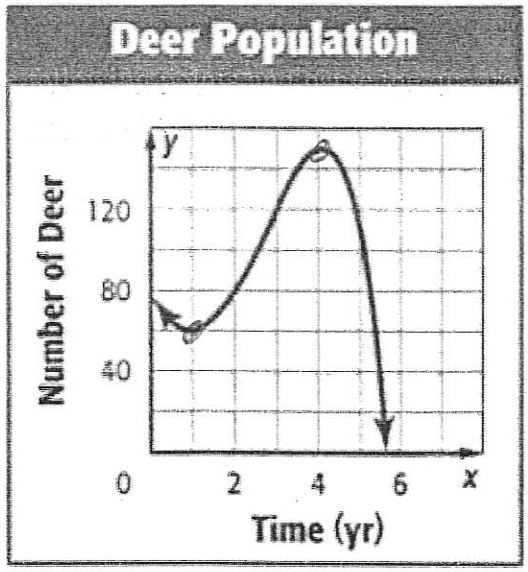


x=30

The cost to produce n more or n less than 30 will be the same.

Example

The graph shows the population y of deer x years after the animals are introduced on an island. Estimate and interpret where the function is:



Positive Yrs 0 to 5.6

Negative 5.6 on, no more deer.

Increasing Yrs 1 to 4

Decreasing Yrs 4 to 6

The x-coordinates of any relative extrema

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The end behavior of the graph. headed to zero. Deer died out about 5.6 yrs after being on island.