1.1 Modeling and Equation Solving

What ways can we model the equation $y = 4x - 3$?

U 10

> Numerically (Table) $|r| = 1$

Pg. 65 Example 2 and #19 Homework

> Algebraically (Formula)

Example

A pizzeria sells a rectangular pizza 10″ by 12″ for the same price as its large round pizza (12″ diameter). If both pizzas are of the same thickness, which option gives the most pizza for the money?

Rect
$l \cdot w$
$10 \cdot 12$
$120 in^2$

Circle
πr^2
$\pi 6^2 = 113.1 in^2$

Rect

Example

Find all real numbers x for which $2x^3 = -3x^2 + 2x$.

$2x^3 + 3x^2 - 2x = 0$

$x(2x^2 + 3x - 2) = 0$ Grouping

-4

$x((2x^2 + 4x) - 1x - 2) = 0$

$(2x)(x+2) - 1(x+2)$

$x(x+2)(2x-1) = 0$

$x = 0 \quad x + 2 = 0 \quad 2x - 1 = 0$

$0, -2, \frac{1}{2}$

You are Finding:
1. Roots
2. Zeros
3. X-intercepts

> Graphically

Grouping

$3x^2 - 13x + 4$ add

12 mult

-12
-1

Replace middle

$(3x^2 - 12x) - 1x + 4$

$(3x)(x-4) - 1(x-4)$

$\boxed{(x-4)(3x-1)}$

4 $\quad$ $\frac{1}{3}$

Polya's Four Problem Solving Steps

1. Understand Problem – Underline #s, Restate
2. Devise a plan – Formula, Picture
3. Carry out the plan
4. Check & Make Sense?

Example

The engineers at an auto manufacturer pay students \$0.10 per mile plus \$20 per day to road test their new vehicles.

(a) How much did the auto manufacturer pay Dennis to drive 200 miles in one day?

(b) Erma earned \$30 test-driving a new car in one day. How far did she drive?

Model $.10x + 20 = y$

miles payment

Algebraically

a) $.10 * 200 + 20$

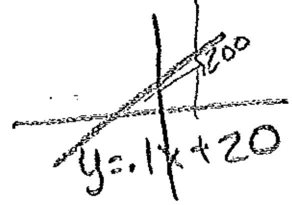
\$40

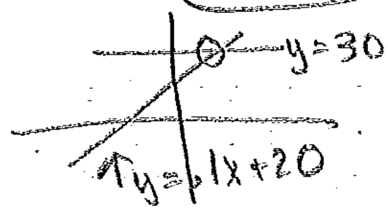
b) $.10x + 20 = 30$

$.10x = 10$

$x = 100$

Graphically





Example w/Partner

Engineers have a tank that contains 50 gallons of water. They let in 10 gallons of water per minute. Answer each question.

(a) How many gallons of water will be in the tank after 12 minutes?

(b) How many minutes will it take for the tank to contain 85 gallons in all?

(c) How many minutes will it take for the tank to contain 700 gallons in all?

Model

$y = 10x + 50$

Algebraically

a) $10 \cdot 12 + 50$

170 gal

b) $85 = 10x + 50$

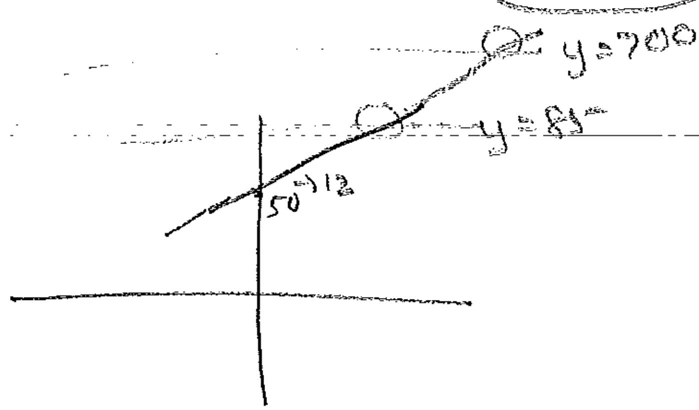
$35 = 10x$

3.5 min

c) $700 = 10x + 50$

65 min

Graphically



Example – Grapher Failure

Solving graphically find all real solutions to the following equations. Watch out for hidden behavior. Confirm your results algebraically.

a) $Y=10x^3 + 7.5x^2 - 54.85x + 37.95$ -3 1.1 1.15

~~b)~~ $Y = x^3 + x^2 - 4.99x + 3.03$

1.2 Functions and their Properties

- **Function –** every element in D (Domain, x) has exactly 1 R (Range, y) (VLT)
- **Domain –** input values
  - **Implied Domain** = algebraic
  - **Relevant Domain** = situational

Ex Cliff diver $-x^2+3$ — Implied $(-\infty,\infty)$ Rel. $[0,\infty)$

- **Range –** Output values

Examples

Linear D $(-\infty,\infty)$ R $(-\infty,\infty)$; Quad $y=x^2$ D $(-\infty,\infty)$ R $[0,\infty)$; Abs. Value $y=|x|$ D $(-\infty,\infty)$ R $[0,\infty)$; Exp $y=2^x$ $(-\infty,\infty)$ $(0,\infty)$; Hyp $y=\frac{2}{x}$ D: $(-\infty,0)\cup(0,\infty)$ R: $(-\infty,0)\cup(0,\infty)$

Find the domain of each of these functions:

(a) $f(x) = \sqrt{x+4}$

no neg under sq. root $x+4 \geq 0$, $x \geq -4$ $\boxed{[-4,\infty)}$

(b) $f(x) = \frac{\sqrt{x}}{x-3}$

no neg $x \geq 0$

no zero on bottom $x-3 \neq 0$, $x \neq 3$

$\boxed{[0,3)\cup(3,\infty)}$

(c) $A(x) = x^2$, where $A(x)$ is the area of a square with sides of length x.

no neg side length $(0,\infty)$

__Example__

Find the range of the functions:

a) $10-x^2$ $(-\infty, 10]$

b) $f(x)=\frac{2}{x}$ $(-\infty, 0)\cup(0, \infty)$

~~$[10, \infty)$~~

$y=\frac{5}{x-1}$ $x-1\neq 0$ $x\neq 1$

D: $(-\infty, 1)\cup(1,\infty)$

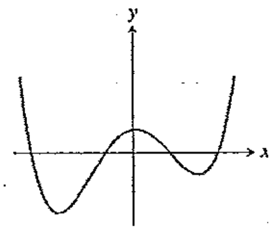
R: $(-\infty, 0)\cup(0,\infty)$

➢ **Continuous Function**

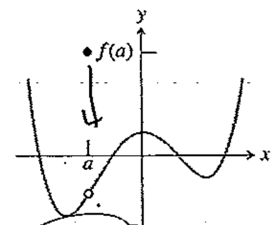
"graph doesn't come apart"

➢ **Discontinuous Function**

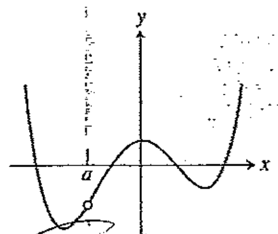
"Breaks"



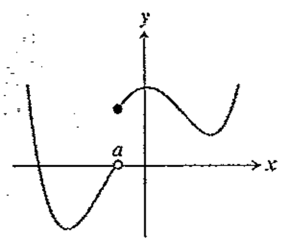
Continuous at all x



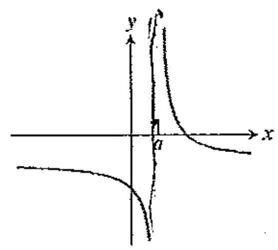
Removable discontinuity



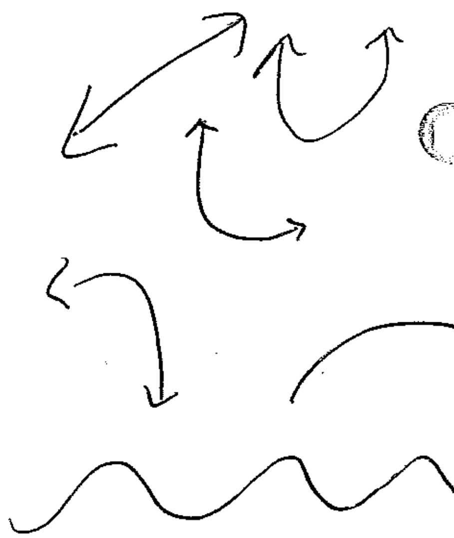
Removable discontinuity



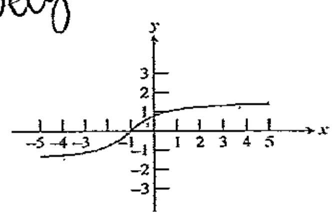
Jump discontinuity

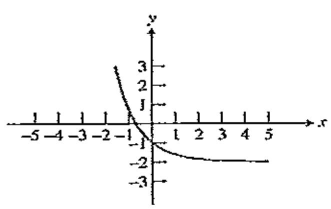


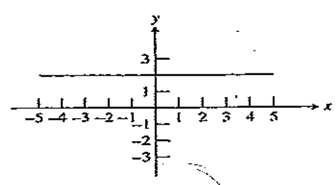
Infinite discontinuity



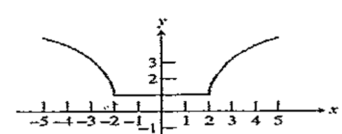
Day 2 - **Increasing** (pos slope) **and Decreasing** (neg slope) **Functions**


Increasing


Decreasing


Constant

0



Decreasing on $(-\infty, -2]$

Constant on $[-2, 2]$

Increasing on $[2, \infty)$

Examples

For each function, tell the intervals on which it is increasing and the intervals on which it is decreasing.

(a) $f(x) = (x-2)^2$

Dec $(-\infty, 2]$

Inc. $[2, \infty)$

(b) $g(x) = \frac{x^2}{x^2-4}$ ← no zero bottom

2 -2 0

Inc $(-\infty, -2) \cup (-2, 0]$

Dec $[0, 2) \cup (2, \infty)$

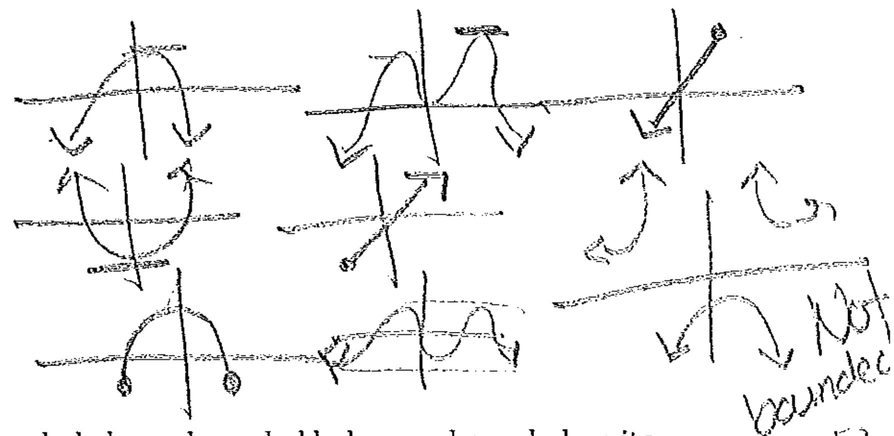
Example

$$Given\ f(x) = |x+3| - |x-2| = \begin{cases} -5 \ if\ x \le -3 \\ 2x+1 \ if\ -3 < x < 2 \\ 5 \ if\ x \ge 2 \end{cases}$$ Piecewise

Find the intervals were f(x) is increasing, decreasing, and constant.

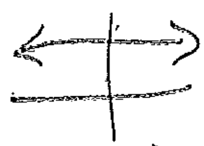
$(-3, 2)$ ~~$\quad$~~ $(-\infty, -3] \cup [2, \infty)$

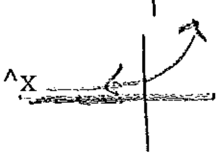
- **Boundedness**
  - **Bounded Above** (we know highest pt)
  - **Bounded Below** (we know lowest pt)
  - **Bounded** (we know Hi Low pt)

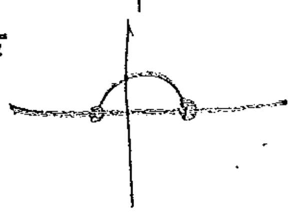


Example

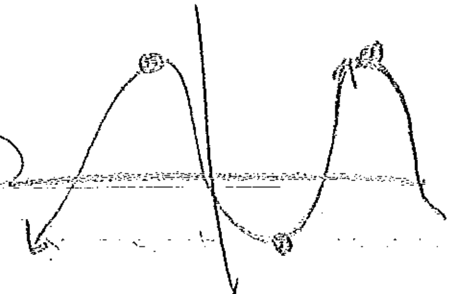
Determine whether the function is bounded above, bounded below, or bounded on its domain.

a) Y = 32  Bounded

b) Y = 2^x  Bounded Below

c) $\sqrt{1-x^2}$  Bounded

- Local Maximum, Local Minimum, Relative Extrema



Example

Decide whether $f(x) = x^4 - 7x^2 + 6x$ has any local maxima or local minima. If so find each and the value of x at which occurs.

.456

-2.056

1.601

Even (y-axis) $(x,y) \to (-x,y)$

Odd origin $(x,y) \to (-x,-y)$

– Symmetry and Odd/Even Functions

Example

Tell whether each of the following functions is odd, even, or neither. Support graphically and confirm algebraically.

(a) $f(x) = 2x^2 + 1$

Plug in -x

$2(-x)^2 + 1$

$2x^2 + 1$

Even

(b) $g(x) = x^2 - 2x + 3$

Not even

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

$x^2 + 2x + 3$

Not odd

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

$x^2 + 2x + 3$

(c) $h(x) = \frac{x^3}{x^2-1}$

Odd

$\frac{(-x)^3}{(-x)^2 - 1}$

$\frac{-x^3}{x^2 - 1}$

$-\frac{x^3}{x^2-1}$

– Asymptotes and End Behavior

- **Horizontal Asymptote**

$y = \#$

① $\frac{x^3}{x^5}$ Bigger Power denom $y = 0$

② $\frac{5x^3}{7x^3}$ same power $y = 5/7$

③ $\frac{x^5}{x^2}$ Bigger power num. None

- **Vertical Asymptote**

$x = \#$ Zeros of denominator

Example

Identify any horizontal or vertical asymptotes of the graph of $y = \frac{x^1}{x^2-4x+3}$ $(x-3)(x-1)$

1 + 3

Hor. $y = 0$

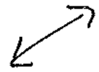
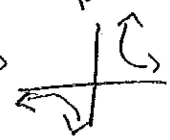
Vert $x = 1$

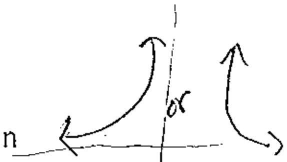
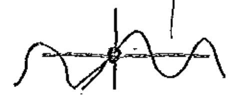
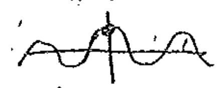
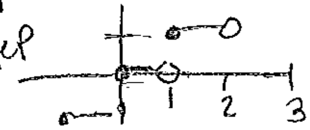
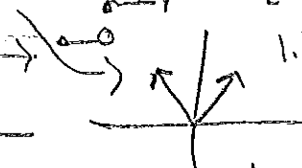
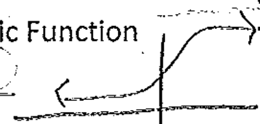
$x = 3$

$\frac{x^2+3}{(x-1)(x-3)}$ $y = 1$

$x^2 - 4x + 3$

1.3 Twelve Basic Functions

1. Identity Function /Linear 
2. Squaring Function 
   Quadratic
3. Cubing Function 
4. Square Root Function 
5. Natural Logarithm Function 
   ln (x)
6. Reciprocal Function 
   $\frac{1}{x}$ Hyperbolas

7. Exponential Function 
   5^x
8. Sine Function  (0,0)
9. Cosine Function  (0,1)
10. Greatest Integer Function Step 
11. Absolute Value Function 
12. Logistic Function 
    $\frac{5}{1+c}$

1.3

(3) 1. *Which functions do not have a domain of all real numbers?* Sq. Root, Reciprocal, ln

(2) 2. *Which functions have points of discontinuity?* Recip. & Greatest Int.

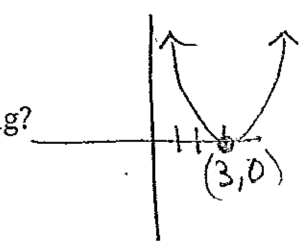
(3) 3. *Which functions are bounded (above and below)?* Sine, Cosine, Logistic

(3) 4. *Which of the functions are even?* y-axis Abs Value, Cosine, Squaring

(3) 5. *Which three functions have horizontal asymptotes at y=0?* Exp, Recip., Logistic

Example

Graph the function $y = (x - 3)^2$. Then answer the following questions:



(3,0)

(a) On what interval is the function increasing? On what interval is it decreasing?

$(3, \infty)$ $(-\infty, 3]$

(b) Is the function odd, even, or neither? Neither

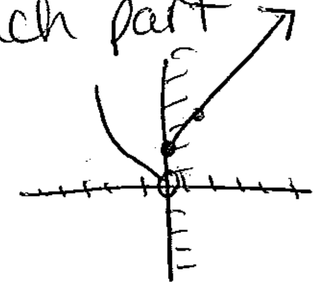
(c) Does the function have any extrema? Yes $x = 3$

(d) How does the graph relate to the graph of the basic function $y = x2$?

$y = x^2$
Shifted 3 rt

➢ Piecewise Function — function whose domain is divided into parts where each part has different function.

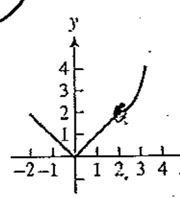
$$f(x) = \begin{cases} x^2 & \text{if } x < 0 \\ x+2 & \text{if } x \geq 0 \end{cases}$$



Example

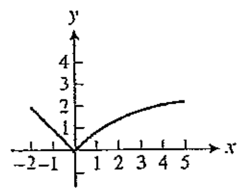
Using basic functions from this section, construct a piecewise definition for the function whose graph is shown. Is your function continuous?

7.



$x^2 - 2$

8.



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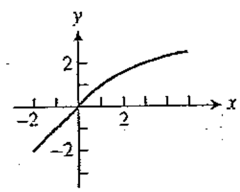

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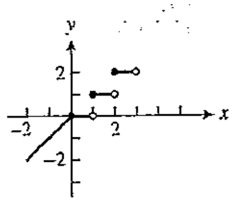
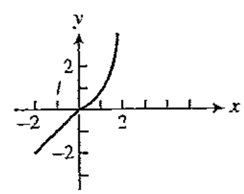
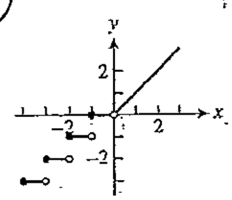


11.



12.



#7
$$f(x) = \begin{cases} |x| & \text{if } x \leq 2 \\ x^2 - 2 & \text{if } x > 2 \end{cases}$$
Yes

#8
$$g(x) = \begin{cases} -x & \text{if } x \leq 0 \\ \sqrt{x} & \text{if } x > 0 \end{cases}$$

#9
$$f(x) = \begin{cases} x & \text{if } x \leq 1 \\ \sqrt{x} & \text{if } x > \end{cases}$$

#10
$$f(x) = \begin{cases} x & \text{if } x \leq 0 \\ \text{int}(x) & \text{if } x > 0 \end{cases}$$

#11
$$f(x) = \begin{cases} x & \text{if } x \leq 0 \\ x^2 & \text{if } x > 0 \end{cases}$$

#12
$$g(x) = \begin{cases} x & \text{if } x \geq 0 \\ \text{int}(x) + 1 & \text{if } x < 0 \end{cases}$$
No

1.4 Building Functions from Functions

Let f and g be two functions with intersecting domains.

Sum $(f+g)(x) = f(x) + g(x)$

Difference $(f-g)(x) = f(x) - g(x)$

Product $(fg)(x) = f(x) \cdot g(x)$ ← Not $f(g(x))$

Quotient $\left(\frac{f}{g}\right)x = \frac{f(x)}{g(x)}$ assume $g(x) \neq 0$

Example

~~Find formulas for~~ the functions f+g, f – g, and fg. Give the domain of each.

f(x) = 2x – 1 g(x) = x^2 + 3

$f+g = 2x-1 + x^2 = x^2+2x-1 \quad (-\infty,\infty)$

$f-g = 2x-1 - x^2 = -x^2+2x-1 \quad (-\infty,\infty)$

$fg = (2x-1)x^2 = 2x^3-x^2 \quad (-\infty,\infty)$

$f-g$

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

$2x-1-x^2-3$

$-x^2+2x-4$

- **Composition of Functions**

$(f\circ g)(x) = f(g(x))$ "f of g of x"

$f(x) = \cancel{x^2+4x-1}$

$g(x) = \cancel{x}-3$ $(x-3)(x-3)$

$f(g(x)) = (x-3)^2+4(x-3)-1$

$x^2-6x+9+4x-12-1$

x^2-2x-4

$g(f(x))$ $g(x^2+4x-1)$

$x^2+4x-1-3$

x^2+4x-4

Example

Let $f(x) = 2^x$ and $g(x) = \sqrt{x}$. Find $(f\circ g)(x)$ and $(g\circ f)(x)$ and verify that the functions $f\circ g$ and $g\circ f$ are not the same. Then find the domain of the compositions.

$f(g(x)) = 2^{\sqrt{x}} \quad [0,\infty)$

$g(f(x)) = \sqrt{2^x} \quad (-\infty,\infty)$

$2^{-5} = \frac{1}{2^5}$

Ex: Area of image is 3x5 and enlarge 1 in per click. How long before Area image is 7 times original size?

Area 15
7x 105

$(3+1x)(5+1x)=105$

➢ **Decomposition of Functions** - Undoing composition

$h(x)=(\cancel{x+1})^2-3(\cancel{x+1})+40$ $f(g(x))$

$f(x)=x^2-3x+40$ $g(x)=x+1$

O $\frac{4}{3}\pi r^3$

Example

For each function h, find functions f and g such that $h(x) = f(g(x))$.

(a) $h(x) = 2(x-5)^2 + 2(x-5)$

$f(x)=2x^2+2x$ $g(x)=x-5$

(b) $h(x) = \sqrt[3]{x^2-3}$

$f(x)=\sqrt[3]{x}$
$g(x)=x^2-3$

OR

$f(x)=\sqrt[3]{x-3}$
$g(x)=x^2$

➢ **Relation** - a set of ordered pairs of real #s

Example

Find two functions defined implicitly by the given relation: $x^2+y^2=25$ Circle

$\sqrt{y^2}=\sqrt{25-x^2}$

$y=\pm\sqrt{25-x^2}$

Find two functions defined implicitly by the given relation: $x+|y|=1$,

$|y|=1-x$

$\boxed{\begin{array}{l} y=1-x \\ y=-1+x \end{array}}$

$|x|=5$

Example

Describe the graph of the relation $4x^2+4xy+y^2=4$.

$\sqrt{(2x+y)^2}=\sqrt{4}$

Parallel Lines

$2x+y=2$ or $2x+y=-2$

$\boxed{y=2-2x}$ $\boxed{y=-2-2x}$

Well Know one unit circle

$x = \cos\theta$

$y = \sin\theta$

ϕ

1.5 Parametric Relations

Consider the set of all ordered pairs (x, y) defined by the equations

$$\begin{cases} x = t - 1 \\ y = t^2 - 1 \end{cases}$$

where t is any real number.

(a) Find the points determined by $t = -3, -2, -1, 0, 1, 2,$ and 3.

t	$x = t-1$	$y = t^2 - 1$	(x, y)
-3	$-3-1=-4$	$(-3)^2-1=8$	$(-4,8)$
-2	-3	3	$(-3,3)$
-1	-2	0	$(-2,0)$
0	-1	-1	$(-1,-1)$
1	0	0	$(0,0)$
2	1	3	$(1,3)$
3	2	8	$(2,8)$

(b) Find an algebraic relationship between x and y. Is y a function of x?

$x = t - 1$ Sub $y = t^2 - 1$

$t = x + 1$

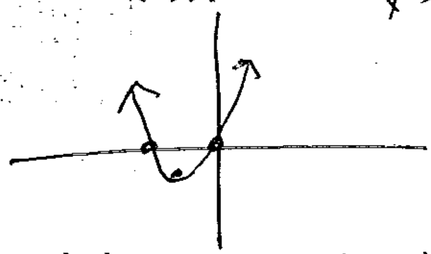
$y = (x+1)^2 - 1$

$x^2 + 2x + 1 - 1$

$y = x^2 + 2x$

Yes

(c) Graph the relation in the (x, y) plane.

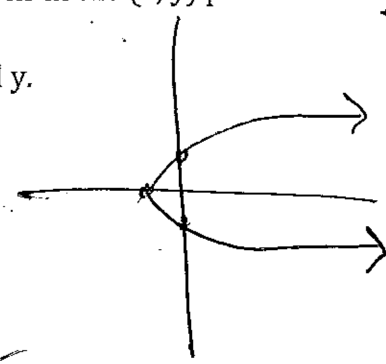


You can change your calculator to parametric mode!

Example (pg. 120)

Consider the set of all ordered pairs (x, y) defined by the equations $x=t^2+2t$ and $y=t+1$ where t is any real number.

a) Use a graphing calculator to find the points determined by t = -3, -2, -1, 0, 1, 2, 3
b) Use a graphing calculator to graph the relations in the (x, y) plane.
c) Is y a function of x? NO
d) Find an algebraic relationship between x and y.



t	(x, y)
-3	$3, -2$
-2	$0, -1$
-1	$-1, 0$
0	$0, 1$
1	$3, 2$
2	$8, 3$
3	$15, 4$

$y = t + 1$

$y - 1 = t$

$x = (y-1)^2 + 2(y-1)$

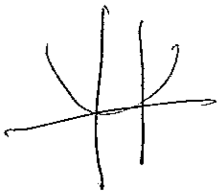
$y^2 - 2y + 1 + 2y - 2$

$x = y^2 - 1$

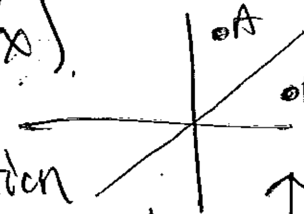
$y = x + 3$

(Day 2)

- **Inverse Relation** – a relation consisting of all ordered pairs (a, b) for which (b, a) are in Relation

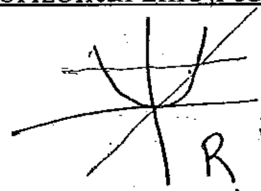


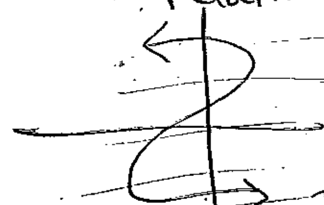
$f(x)$ $\qquad$ $f^{-1}(x)$

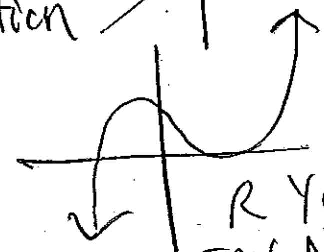


Reflection $y = x$

- **Horizontal Line Test** – inv. of relation is function







- **Inverse Function** – inverse relation that is a function

$f^{-1}(b) = a$ iff $f(a) = b$

> 1 to 1 = VLT & HLT

> F is 1 to 1 w/ inv. G $\quad f(g(x)) = x$ <u>and</u> $g(f(x)) = x$

$y = x$ Reflect over

Example

Find the equation for f^{-1} if $f(x) = \frac{2x}{2x-1}$

$y = \frac{2x}{2x-1}$

To find inv. switch x & y

$(2y-1) \cdot x = \frac{2y}{\cancel{2y-1}} \cdot \cancel{2y-1}$

$2xy - x = 2y$

$2xy - 2y = x$

$y(2x-2) = x$

$\boxed{y = \frac{x}{2x-2}}$

$f(x) = \frac{x+1}{x-1}$

f^{-1}: $(y-1) \cdot x = \frac{y+1}{\cancel{y-1}} \cdot \cancel{y-1}$

$xy - x = y + 1$

$xy - y = x + 1$

$y(x-1) = x + 1$

$y = \frac{x+1}{x-1}$

Example

Show that $f(x)=\sqrt{2x-3}$ has an inverse function and state a rule for $f^{-1}(x)$. State any restrictions on the domains f(x) and $f^{-1}(x)$.

$2x - 3 \geq 0$

$x \geq 1.5$

f(x) = D: [1.5, ∞)

R: [0, ∞)

f^{-1}: $x = \sqrt{2y-3}$

$x^2 = 2y - 3$

$x^2 + 3 = 2y$

$y = \frac{x^2+3}{2}$

D: [0, ∞)

Translation (Slide)
Rotation
Reflection
Dilation.
$\left.\right\}$ Isometries (congruent)

1.6 Graphical Transformations

- Rigid Transformations – Same size + shape
- Nonrigid Transformations – distort shape "stretch or shrinks"
- Horizontal Translations – Left $(x+3)^2$ Rt $(x-3)^2$ $y=x^2$
- Vertical Translations – Up x^2+3 Down x^2-3 vertex
- Reflections
  - X-axis $(x, y) \rightarrow (x, -y)$
  - Y-axis $(x, y) \rightarrow (-x, y)$
  - Origin $(x, y) \rightarrow (-x, -y)$

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

$(3, 7)$

- * Horizontal Stretches or Shrinks
  $y=f\left(\frac{x}{c}\right)$ $c>1$ stretch, $c<1$ shrink
  $y=(3x)^3$ shrink by $1/3$
  $y=\left(\frac{1}{2}x\right)^3$ stretch 2
- Vertical Stretches or Shrinks
  $y=c\cdot f(x)$ $c>1$ stretch, $c<1$ shrink
  $y=3\cdot x^3$ Stretch
  $y=\frac{1}{4}x^3$ shrink

$y=x^4$

$y=(x-3)^4$

Example

Find an equation for the reflection of $f(x)=\frac{3x+2}{x^2+1}$ across each axis. Support graphically.

x-axis (make y neg) $\frac{-1}{1}\cdot\frac{3x+2}{x^2+1} = \frac{-3x-2}{x^2+1}$

y-axis (make x neg) $\frac{3(-x)+2}{(-x)^2+1} = \frac{-3x+2}{x^2+1}$

Example

$x^3 - x$

Let $C1$ be the curve defined by $y1 = f(x) = x3 - x$. Find equations for the following nonrigid transformations of $C1$:

(a) $C2$ is a vertical stretch of $C1$ by a factor of 2. $2(x^3 - x) = \boxed{2x^3 - 2x}$

(b) $C3$ is a horizontal shrink of $C1$ by a factor of $1/4$.

$\frac{x^3 - x}{1/4}$ $\quad 4(x^3 - x)$

$\boxed{= 4x^3 - 4x}$

(Day 2) – Combining Transformations

Example

$y = x^2$

(a) The graph of $y = x2$ undergoes the following transformations, in order. Find the equation of the graph that results.

- a horizontal shift 3 units to the left $\quad y = (x+3)^2$
- a vertical stretch by a factor of 2 $\quad y = 2(x+3)^2$
- a vertical translation 4 units down. $\quad y = 2(x+3)^2 - 4$ ✓

$x^2 + 6x + 9$

$y = 2x^2 + 12x + 14$

(b) Apply the transformations in (a) in the opposite order and find the equation of the graph that results.

$y = x^2 - 4$

$y = 2(x^2 - 4)$

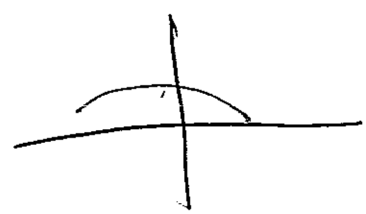
$2x^2 - 8$

$y = 2(x+3)^2 - 8$ ✓

$x^2 + 6x + 9$

$2x^2 + 12x + 18 - 8$

$= 2x^2 + 12x + 10$



Example

The graph of $y = f(x)$ is shown in Figure 1.20. Determine the graph of the composite function $y = 2f(x - 1) - 2$ by showing the effect of a sequence of transformations on the graph of $y = f(x)$.

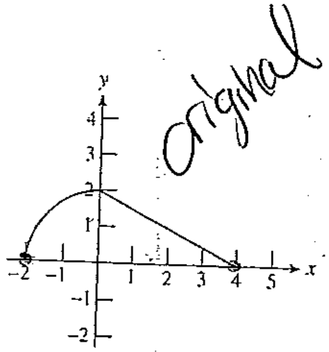


Figure 1.20 The graph of the function $y = f(x)$ in Alternate Example 7.

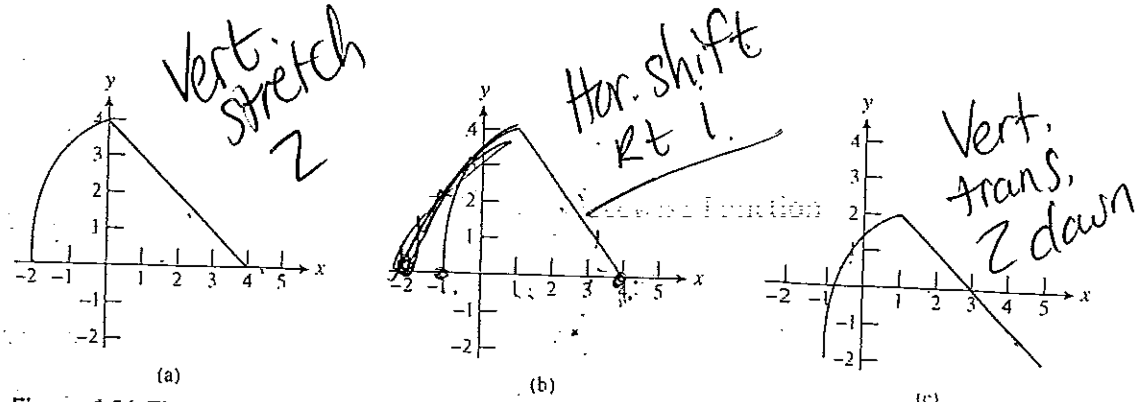


Figure 1.21 The graph of the function $y = f(x)$

In Exercises 13–18, the graph of $y = x^2$ undergoes the following transformations, in order. (a) Find the equation of the graph that results. (b) Apply the transformations in (a) ~~in the opposite order and find the equation of the graph~~ that results.

13. a horizontal shift 2 units to the right
    a vertical shrink by a factor of 1/2
    a vertical translation 2 units up.
14. a horizontal shift 1 unit to the right
    a vertical stretch by a factor of 3
    a vertical translation 1 unit down.
15. no horizontal shift
    a horizontal stretch by a factor of 2
    a vertical translation 3 units up.
16. a horizontal shift 3 units to the left
    no horizontal or vertical stretch or shrink
    a vertical translation 1 unit down.
17. a horizontal shift 4 units to the right
    a vertical stretch by a factor of 3
    a vertical translation 4 units up.
18. a horizontal shift 2 units to the left
    a horizontal shrink by a factor of 1/4
    a vertical translation 5 units down.

13 $y = (x-2)^2$

$y = \frac{1}{2}(x-2)^2$

$y = \frac{1}{2}(x-2)^2 + 2$

16 $y = (x+3)^2 - 1$

14 $3(x-1)^2 - 1$

17 $y = 3(x-4)^2 + 4$

15 $(\frac{1}{2}x)^2 + 3$

18 $\dfrac{(x+2)^2}{1/4}$

$\boxed{4(x+2)^2 - 5}$

1.7 Modeling with Functions

Recall: We can represent functions with formulas, graphs, tables, and verbal descriptions.

FORMULAS

Example

A right circular cylinder has height 8 inches. Write the volume V of the cylinder as a function of its base

$V = \pi r^2 h$

$\frac{V}{\pi h} = r^2$

(a) radius $r = \sqrt{\frac{V}{\pi 8}}$

(b) diameter $d = 2\sqrt{\frac{V}{8\pi}}$ $\quad d = 2r$

(c) circumference $2\pi r$ $\quad C = 2\pi\sqrt{\frac{V}{8\pi}}$

Try It:

Write a formula for the situation using known files.

$(l \cdot w)h$

a) A right rectangular prism has height 10 cm. Its base is a square. Write functions for the volume V in terms of the length s of a side of the base and in terms of the perimeter P of the base.

$V = s^2 \cdot 10$ $\quad V = \left(\frac{P}{4}\right)^2 \cdot 10$ $\quad V = \frac{10P^2}{16} = \frac{5P^2}{8}$ $\quad \frac{P}{4} = \frac{4s}{4}$ $\quad s = P/4$

b) A rectangle has length 4 and width w. Write functions for the area A in terms of length and width and in terms of the perimeter.

$A = 4w$ $\quad P = 8 + 2w$

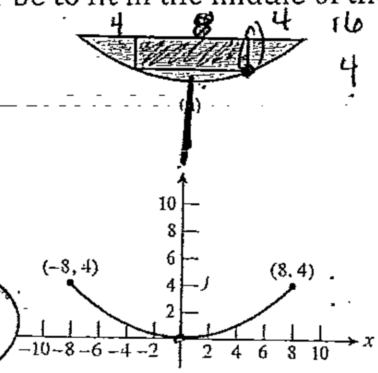
$= 4\left(\frac{P-8}{2}\right)$ $\quad \frac{P-8}{2} = w$

$= \frac{4P-32}{2} = 2P-16$

GRAPHS

Example

A small satellite dish is packaged with a cardboard cylinder for protection. The parabolic dish is 16 in. in diameter and 4 in. deep, and the diameter of the cardboard cylinder is 8 in. How tall must the cylinder be to fit in the middle of the dish and be flush with the top of the dish? (See Figure)



16
4

$y = kx^2$

$4 = k \cdot 8^2$

$k = 1/16$

$y = 1/16\, x^2$

$y = 1/16 \cdot 4^2$

$y = 1$

$4 - 1 = 3\text{in}$

Cone

VERBAL DESCRIPTION

$V = \frac{1}{3}\pi r^2 h$

Example

Grain is leaking through a hole in a storage bin at a constant rate of 5 cubic inches per minute. The grain forms a cone-shaped pile on the ground below. As it grows, the height of the cone always remains equal to its radius. If the cone is one foot tall now, how tall will it be in two hours?

120min

① $\frac{1}{3}\pi h^2 h$

$\frac{1}{3}\pi h^3$

$\frac{1}{3}\pi 12^3$

$= 576\pi \text{ in}^3$

Now

② $5 \times 120 = 600 \text{ in}^3$

$V = 576\pi + 600 \text{ in}^3$

(~~Day 2~~) *TABLES*

Construct a function to predict the housing CPI for the years 2008-2015.

Year		Housing CPI
1990	x = 0	128.5
1995	5	148.5
2000	10	169.6
2002	12	180.3
2003	13	184.8
2004	14	189.5
2005	15	195.7
2006	16	203.2
2007	17	209.6

.995

.998

.9996 x^3

.9996 x^4

- Correlation Coefficient

$|r| = 1$

2nd - 0

Diag. On

A.93

*Solution need 40L all together

25% acid

75% sol. & final to be 15% acidic.

Total

$.25x + .75(40-x) = 40 \cdot .15$