16 Graphs Assignment

This assignment explores the details of 16 different functions, their graphs and the mathematical concepts that they illustrate.

Page	Title	Action
157	Concepts Worksheet 1	For information only. Graphs will be graded on pages 166-189
158	Graphical Analysis	Complete this page. Will need for graphs on pages 166-189
159	Concept Connectors	Complete this page
160-162	Concepts Worksheet 2	Complete these pages
163	Concept Connectors	Complete this page
164	Grading Rubric Sample	Checklist for scoring graphs on page 166-189
165	Example Graph	Demonstrates many of the features of a graph
166-189	Blank Graphing Pages	Complete the 16 graphs on these pages

The graphs include alternate the graphs include two alternate graph forms: 1) Color Bars (dynagraphs) and 2) Mappings. A sample of a completed graph can be found here.

blank

Name _____

Concepts Worksheet 1

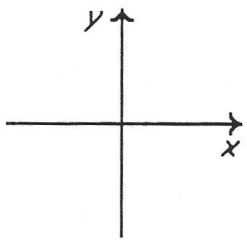
Chapter 1 For use after Article 1.4.

Graphical Analysis

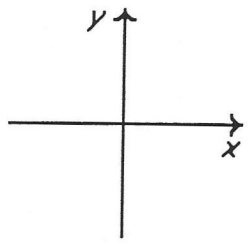
Chapter 1 deals with functions and their characteristics. To facilitate a study of functions, it is important to visualize mentally the graphical image of a function when given an algebraic description.

I. Graph each function. Clearly indicate units on the axes provided.

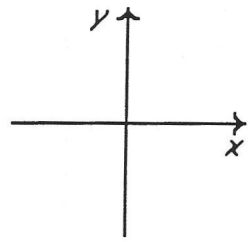
1. $f(x) = x$



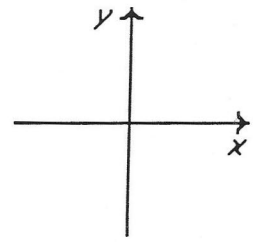
2. $f(x) = x^2$



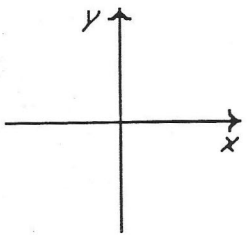
3. $f(x) = x^3$



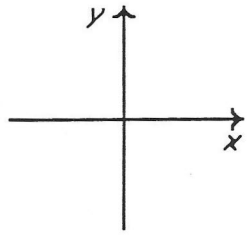
4. $f(x) = |x|$



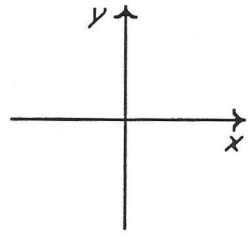
5. $f(x) = [x]$



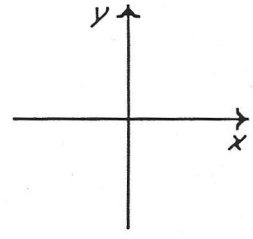
6. $f(x) = \sin x$



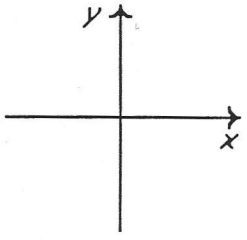
7. $f(x) = \cos x$



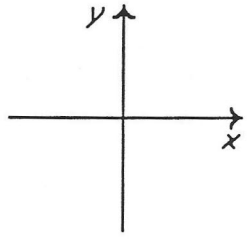
8. $f(x) = \tan x$



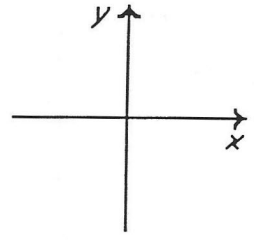
9. $f(x) = \sec x$



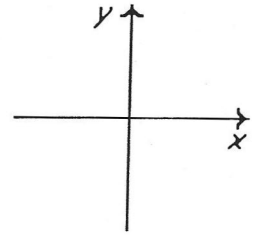
10. $f(x) = 2^x$



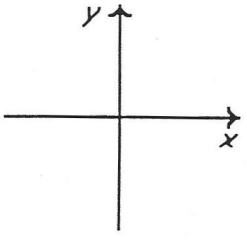
11. $f(x) = \log_2 x$



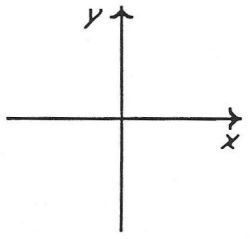
12. $f(x) = \dfrac{1}{x}$



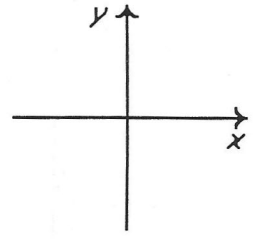
13. $f(x) = \dfrac{1}{x^2}$



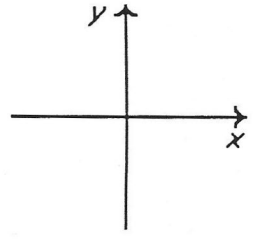
14. $f(x) = \sqrt{x}$



15. $f(x) = \sqrt{a^2 - x^2}$



16. $f(x) = \begin{cases} 0, & \text{if } x \text{ is rational} \\ 1, & \text{if } x \text{ is irrational} \end{cases}$



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II. Graphical Analysis

II. Answer the following questions about the indicated functions. In completing the table below use the following abbreviations, R: the set of real numbers, J: the set of integers, and N: the set of natural numbers. NOTE: This exercise may need to be done as appropriate sections of Chapter 1 are completed.

Function	Domain	Range $y = f(x)$	Roots (Find x when $f(x) = 0$)	Symmetry with respect to y-axis or origin	Even or Odd Function— $f(-x) = f(x)$ or $f(-x) = -f(x)$	Is the function periodic? If so, state the period.	Is $f(x)$ a one-to-one mapping? (For each $f(x)$ only one x exists)	State the x coordinates of any points of discontinuity
1. $f(x) = x$								
2. $f(x) = x^2$								
3. $f(x) = x^3$								
4. $f(x) = \lvert x \rvert$								
5. $f(x) = [x]$								
6. $f(x) = \sin x$								
7. $f(x) = \cos x$								
8. $f(x) = \tan x$								
9. $f(x) = \sec x$								
10. $f(x) = 2^x$								
11. $f(x) = \log_2 x$								
12. $f(x) = 1/x$								
13. $f(x) = 1/x^2$								
14. $f(x) = \sqrt{x}$								
15. $f(x) = \sqrt{a^2 - x^2}$								
16. $f(x) = \begin{cases} 0, & x \text{ is rational} \\ 1, & x \text{ is irrational} \end{cases}$								

III. Concept Connectors

1. Is there a relationship between symmetry in a function's graph and the function's being even or odd?

_____

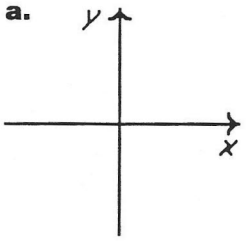
_____

_____

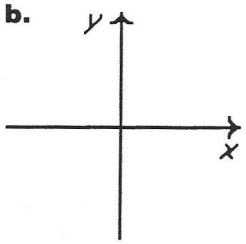
_____

2. Draw a reflection of a) $f(x) = [x]$, b) $f(x) = \sin x$, c) $f(x) = 2^x$ and d) $f(x) = \sqrt{x}$ across the line $y = x$. Which of the reflected images are functions? _____

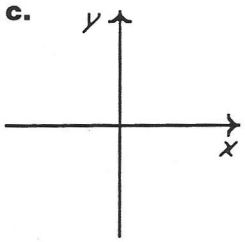
a.



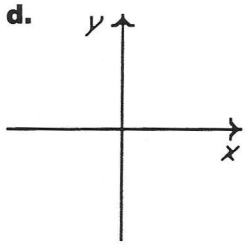
b.



c.



d.



3. Is there a characteristic of a function that assures that its reflection across the line $y = x$ is a function?

_____

_____

_____

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Name _____

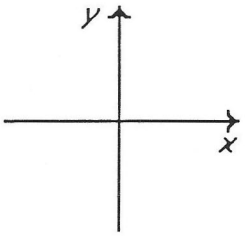
Concepts Worksheet 2

Chapter 1 For use after Article 1.4.

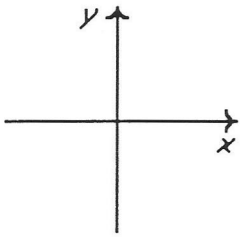
Graphical Transformations

Graph each indicated function on the coordinate axes provided. Clearly indicate units on each axis.

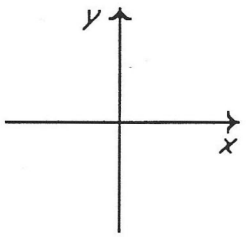
1.a. Graph $f(x) = 2x + 1$



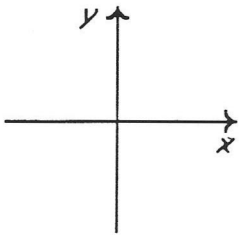
b. Using $f(x)$ above, graph $g(x) = f(-x)$



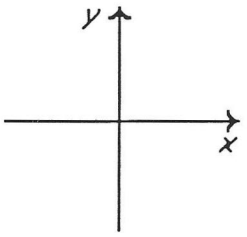
2.a. Graph $f(x) = \sqrt{x}$



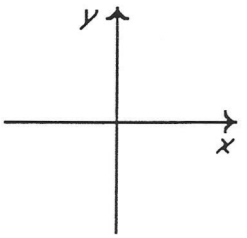
b. Using $f(x)$ above, graph $g(x) = -f(x)$



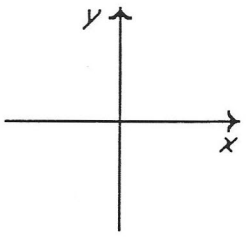
3.a. Graph $f(x) = 2^x$



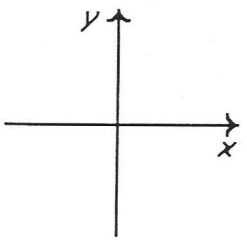
b. Using $f(x)$ above, graph $g(x) = f(x) + 1$



4.a. Graph $f(x) = x^2$



b. Using $f(x)$ above, graph $g(x) = f(x - 2)$



5. Generalize what is happening geometrically when using $f(x)$ to obtain the graph of:

a. $f(-x)$ _____

b. $-f(x)$ _____

c. $f(x) + c$ _____ for $c > 0$

_____ for $c < 0$

d. $f(x - c)$ _____ for $c > 0$

_____ for $c < 0$

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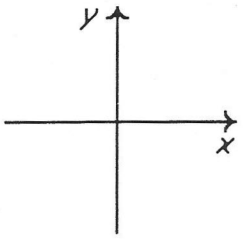
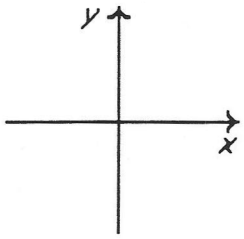
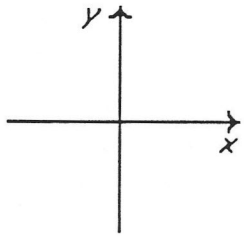
6.a. Graph $f(x) = \sin x$



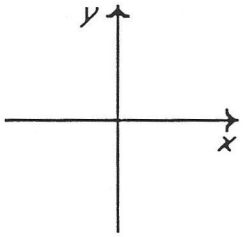
b. Using $f(x)$ in a, graph $g(x) = 2f(x)$



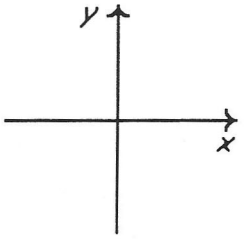
c. Using $f(x)$ in a, graph $h(x) = f(2x)$



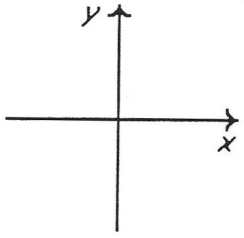
7.a. Graph $f(x) = |x|$



b. Using $f(x)$ in a, graph $g(x) = \frac{1}{3}f(x)$



c. Using $f(x)$ in a, graph $h(x) = f\left(\frac{x}{3}\right)$



8. Generalize what geometric transformation takes place when using $f(x)$ to obtain the graph of:

a. $cf(x)$ _____ for $c > 1$

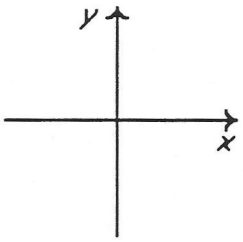
and _____ for $0 < c < 1$

b. $f(cx)$ _____ for $c > 1$

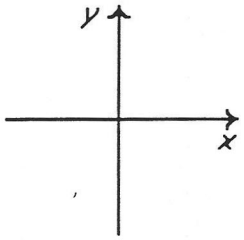
and _____ for $0 < c < 1$

9. Using a basic function (one of the 16 from Worksheet 1) and transformational geometry, quickly sketch the following. Indicate units on the coordinate axes.

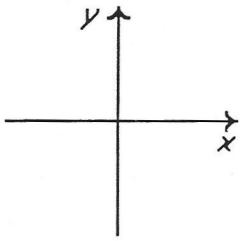
a. $f(x) = 2^{-x}$



b. $f(x) = -\sec x$



c. $f(x) = 2[\![x]\!]$



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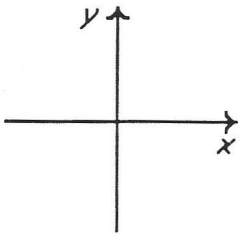
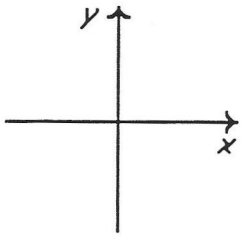
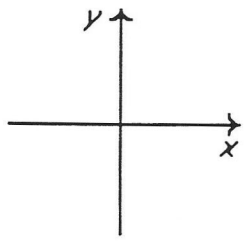
d. $f(x) = (x + 1)^3$



e. $f(x) = 1 + \frac{1}{x^2}$



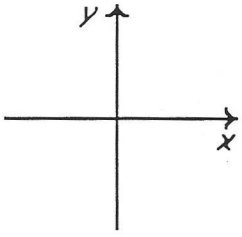
f. $f(x) = \tan\left(x - \frac{\pi}{4}\right)$

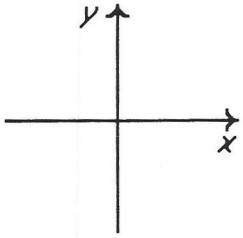


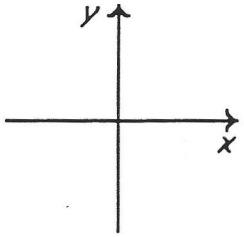
10. a. Using $f(x) = \frac{1}{x}$ as the basic function, describe a sequence of geometric transformations involved in graphing $f_4(x) = \frac{-2}{x - 3}$. Sketch the sequence of transformations below and algebraically describe each function graphed: (NOTE: The sequence of steps may vary.)

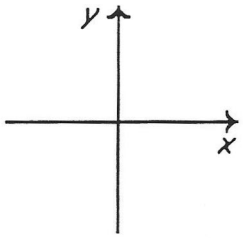
Beginning with $\rightarrow$ ..... $\rightarrow$ and ending with

$f_1(x) = \frac{1}{x}$ $\quad$ $f_2(x) =$ _____ $\quad$ $f_3(x) =$ _____ $\quad$ $f_4(x) = \frac{-2}{x - 3}$





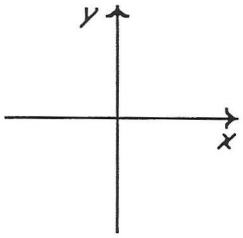


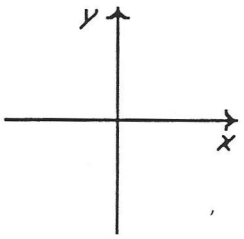


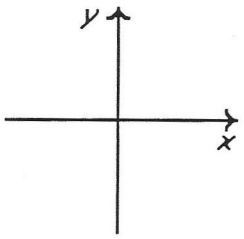
b. Sketch a sequence of geometric transformations and state the algebraic description of each function as done in part(a):

Beginning with $\rightarrow$ ..... $\rightarrow$ and ending with

$f_1(x) = \log_2 x$ $\quad$ $f_2(x) =$ _____ $\quad$ $f_3(x) = \log_2(1 - x)$







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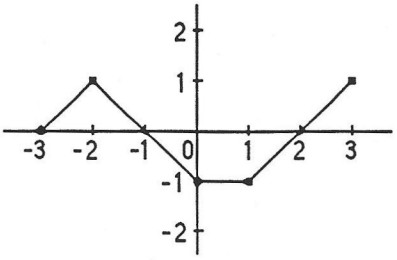
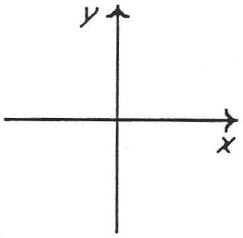
Concept Connectors

11. Given the graph of $f(x)$ as shown below over the domain $-3 \leq x \leq 3$

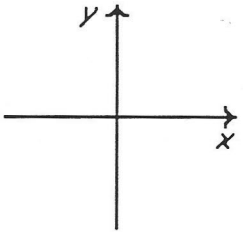


Graph (indicate units on the coordinate axes):

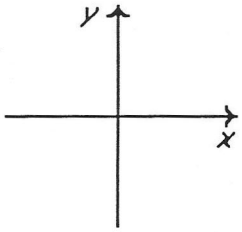
a. $f_1(x) = f(-x)$



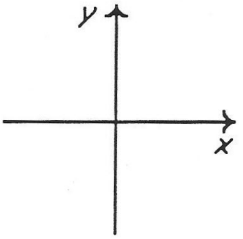
b. $f_2(x) = -f(x)$



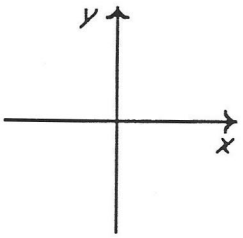
c. $f_3(x) = f(x) - 1$



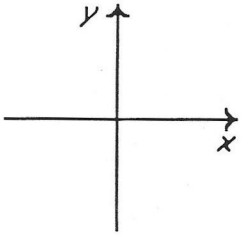
d. $f_4(x) = f(x - 1)$



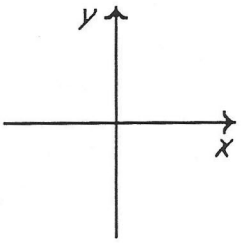
e. $f_5(x) = f(2x)$



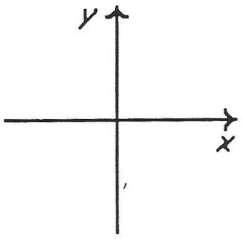
f. $f_6(x) = 1 - f(x)$



g. $f_7(x) = f(2 - x)$



h. $f_8(x) = \frac{1}{2} f\left(\frac{x}{2}\right)$



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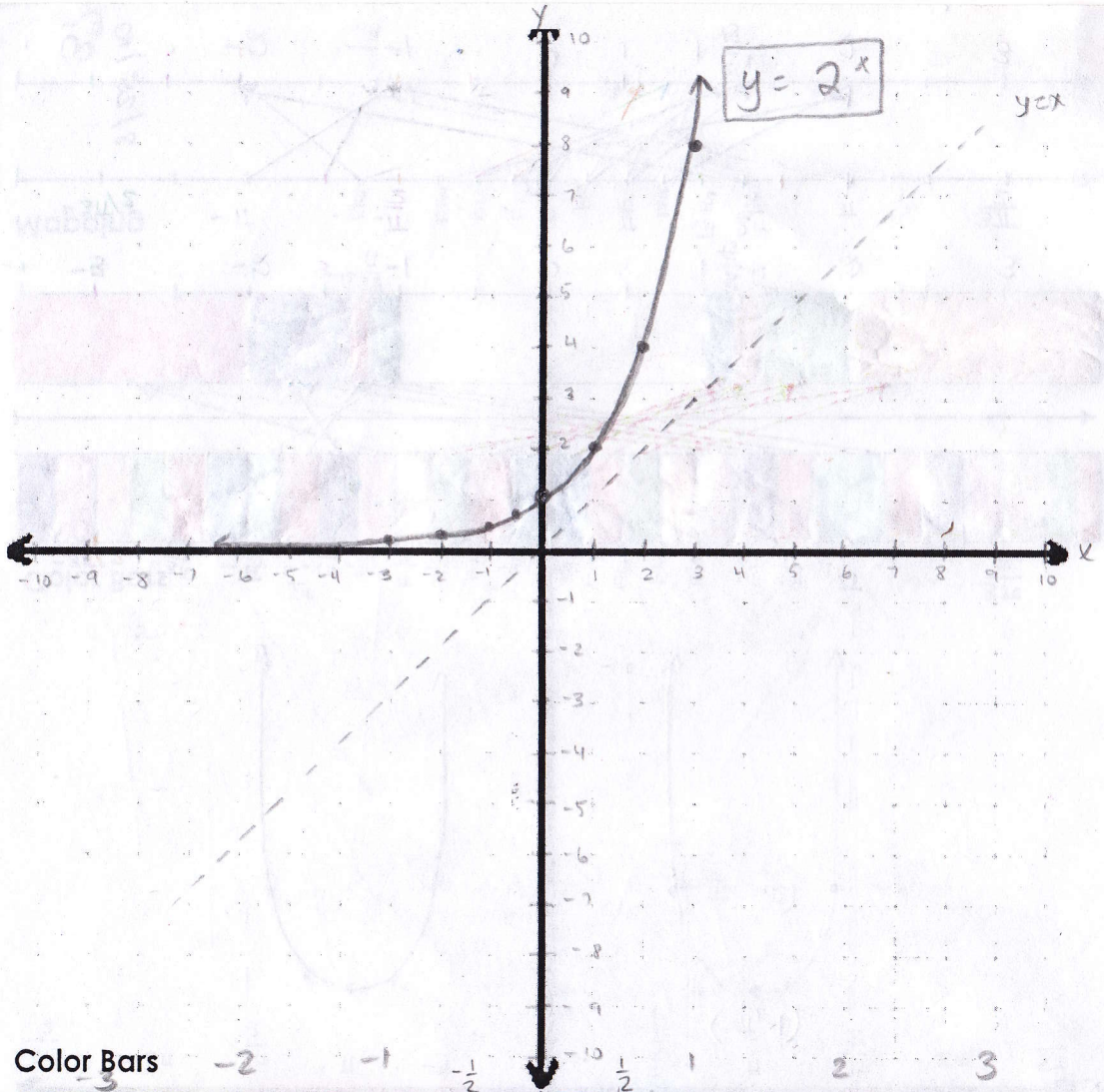
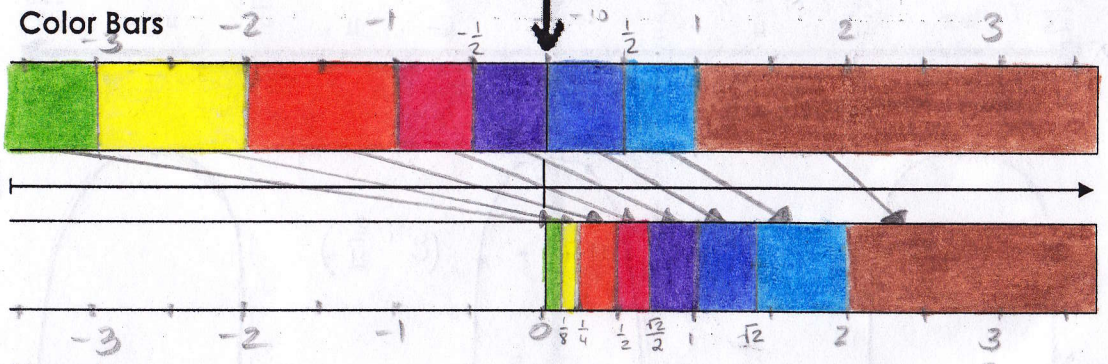
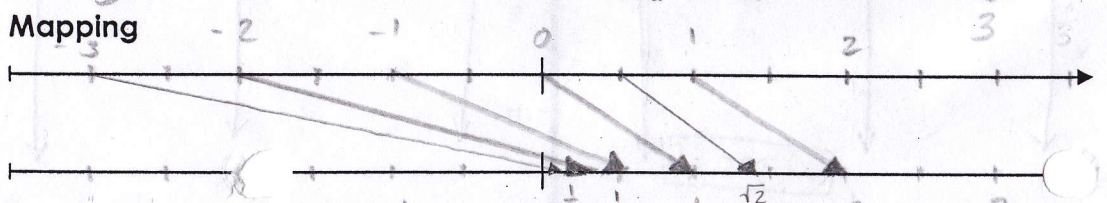
	g	r	a p h	n e a t	a c c u r	r e f	d o m i n t	d o m i n t	d o m i n t	d o m i n t	t a b l e	m a p	c b a r	c b i n t	c b i n t	c b i n t	d o m a i n	r a n g e	r o o t s	s y m m	o d d e v	f a n a l	l i m i t	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total
1 x																								
2 x^2																								
3 x^3																								
4 |x|																								
5 [x]																								
6 sin(x)																								
7 cos(x)																								
8 tan(x)																								
9 sec(x)																								
10 2^x																								
11 $\log_2 x$																								
12 $1/x$																								
13 $1/x^2$																								
14 $\sqrt{x}$																								
15 $\sqrt{a^2 - x^2}$																								
16 irr/rat																								

1-3: axis labeled, scale equal, function name
4: Is the graph neat?
5: Is the graph accurate? Check important points for each function.
6: Is the reference line drawn in?
7-10: Is the domain drawn so information is easy to read? Scale, points of interest
11: Table of values
12: Is there a mapping graph?
13-16: Is there a color bar graph? Does color bar domain match the graph's domain? Directly below? Points of Interest?
17: Is the domain correct and prominently displayed? Discontinuities discussed?
18: Is the range correct and prominently displayed?
19: Are all roots and intercepts listed?
20: Are all symmetries listed?
21: Is there an indication of whether the function is ODD, EVEN or NEITHER?
22: Are properties of WELL DEFINED, ONE-TO-ONE, ONTO and PERIODIC identified correctly?
23: Are all asymptotes correctly identified and correctly labeled with the proper limit expression?







Function: $f(x) = 2^x$

Table of Values

X	-3	-2	-1	$-\frac{1}{2}$	0	$\frac{1}{2}$	1	2	3
Y	$\frac{1}{8}$	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{\sqrt{2}}{2}$	1	$\sqrt{2}$	2	4	8

	Interval	Absolute Value	Name
Domain	$(-\infty, \infty)$	$\lvert x \rvert < \infty$	All $\mathbb{R}$.
Range	$(0, \infty)$	Not Applicable.	All $\mathbb{R} > 0$.

Roots(List)	**Y-Intercept**
None	1

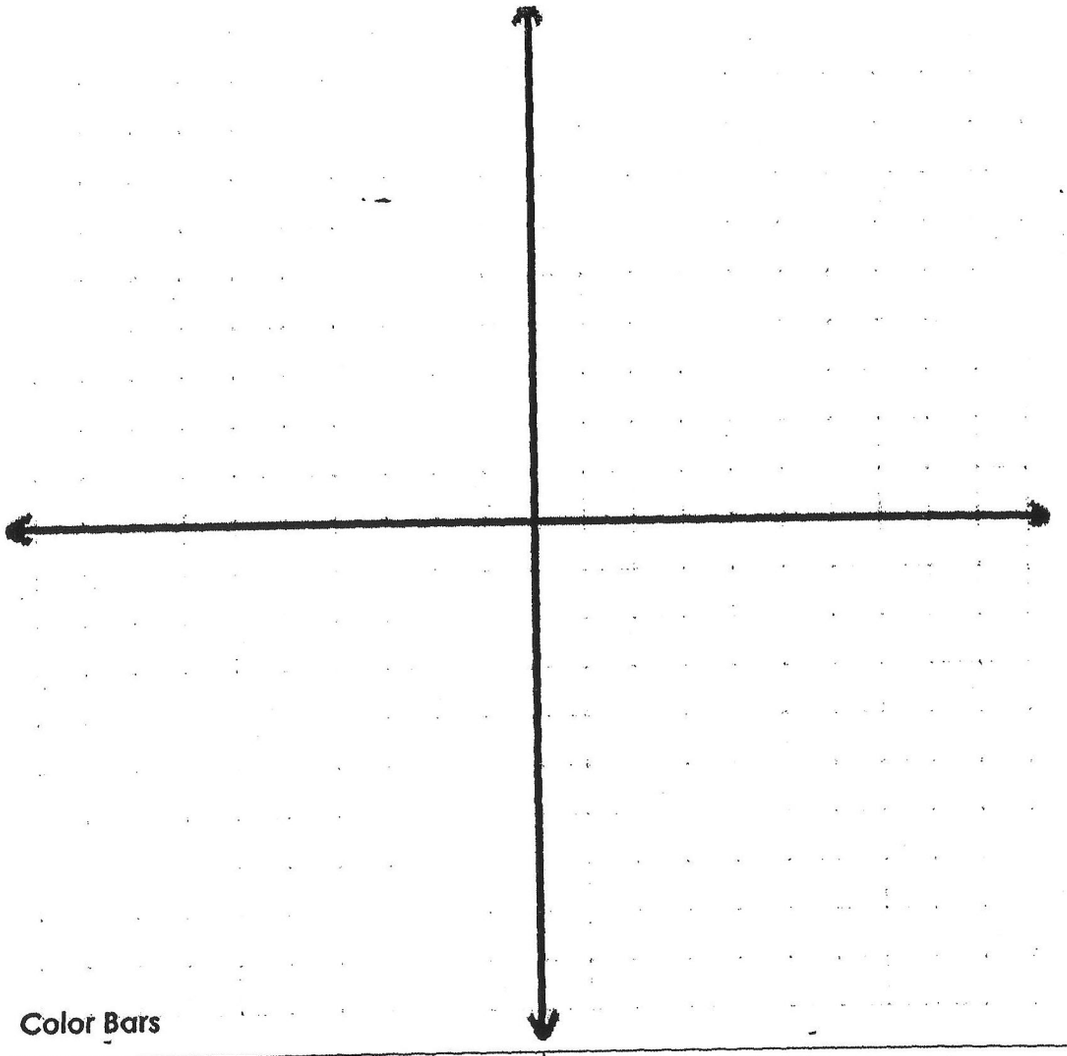
Symmetries?		
y-axis	Yes	(No)
Y=x	Yes	(No)
Origin	Yes	(No)

Even? $f(x) = f(-x)$	Yes	(No)
Odd? $f(x) = -f(-x)$	Yes	(No)

Periodic?	Yes: Period=	(No)
One-to-One?	(Yes)	No
Onto? All $\mathbb{R} > 0$.	(Yes)	No

Discontinuities?		
Removable	Undefined	$\pm\infty$
None	None	None

Asymptotes?	
Horizontal $\lim_{x\to\infty} f(x)$	None
Horizontal $\lim_{x\to-\infty} f(x)$	$y = 0$
Vertical $\lim_{x\to a} f(x)$	None
Oblique (equation)	None



Color Bars

Mapping

Function: _____

Table of Values

X	
Y	

	Interval	Absolute Value	Name
Domain			
Range			

Roots(List)	**Y-Intercept**

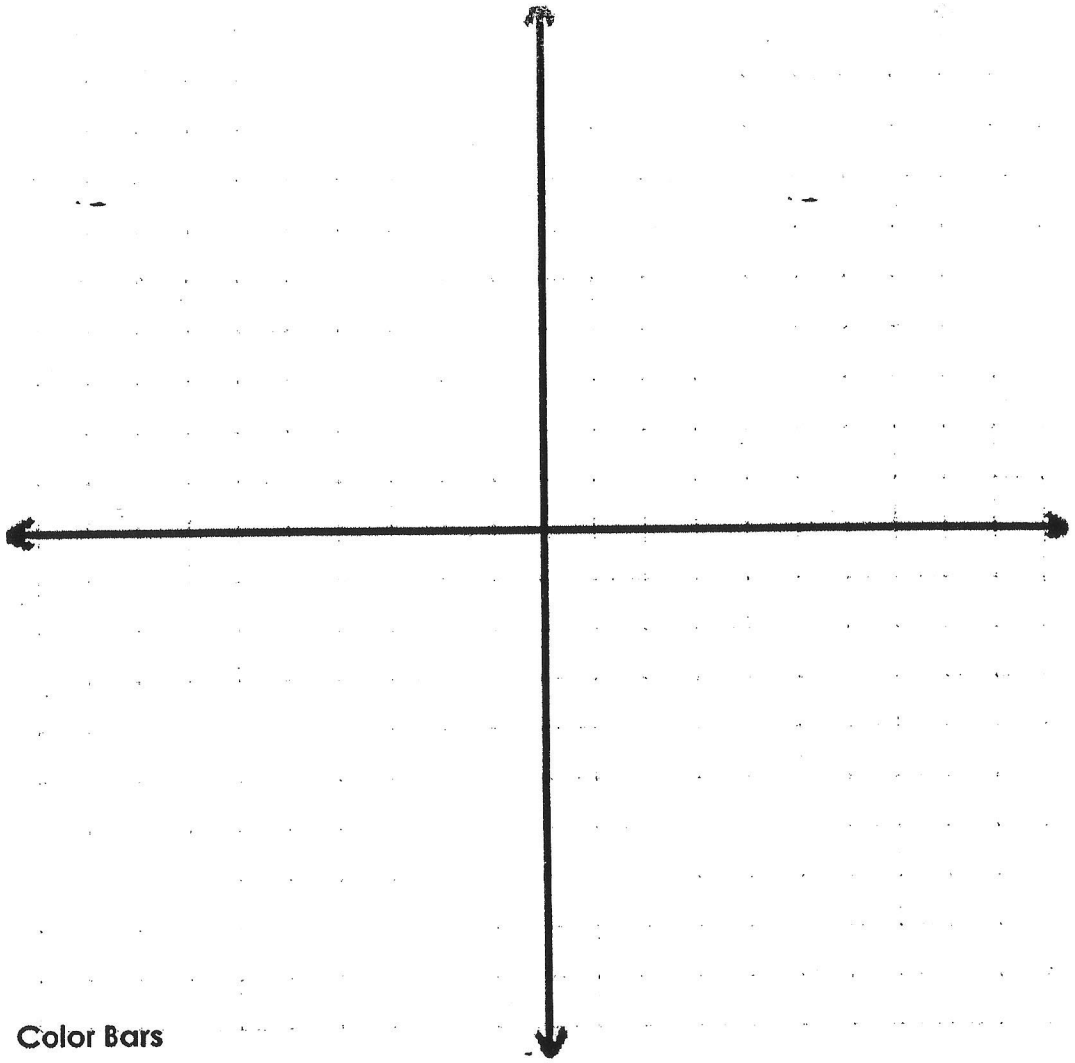
Symmetries?		
y-axis	Yes	No
Y=x	Yes	No
Origin	Yes	No

Even? $f(x) = f(-x)$	Yes	No
Odd? $f(x) = -f(-x)$	Yes	No

Periodic?	Yes: Period=	No
One-to-One?	Yes	No
Onto?	Yes	No

Discontinuities?		
Removable	Undefined	$\pm\infty$

Asymptotes?	
Horizontal $\lim_{x\to\infty} f(x)$	
Horizontal $\lim_{x\to-\infty} f(x)$	
Vertical $\lim_{x\to a} f(x)$	
Oblique (equation)	



Color Bars

Mapping

Function: _____

Table of Values

X	
Y	

	Interval	Absolute Value	Name
Domain			
Range			

Roots(List)	**Y-Intercept**

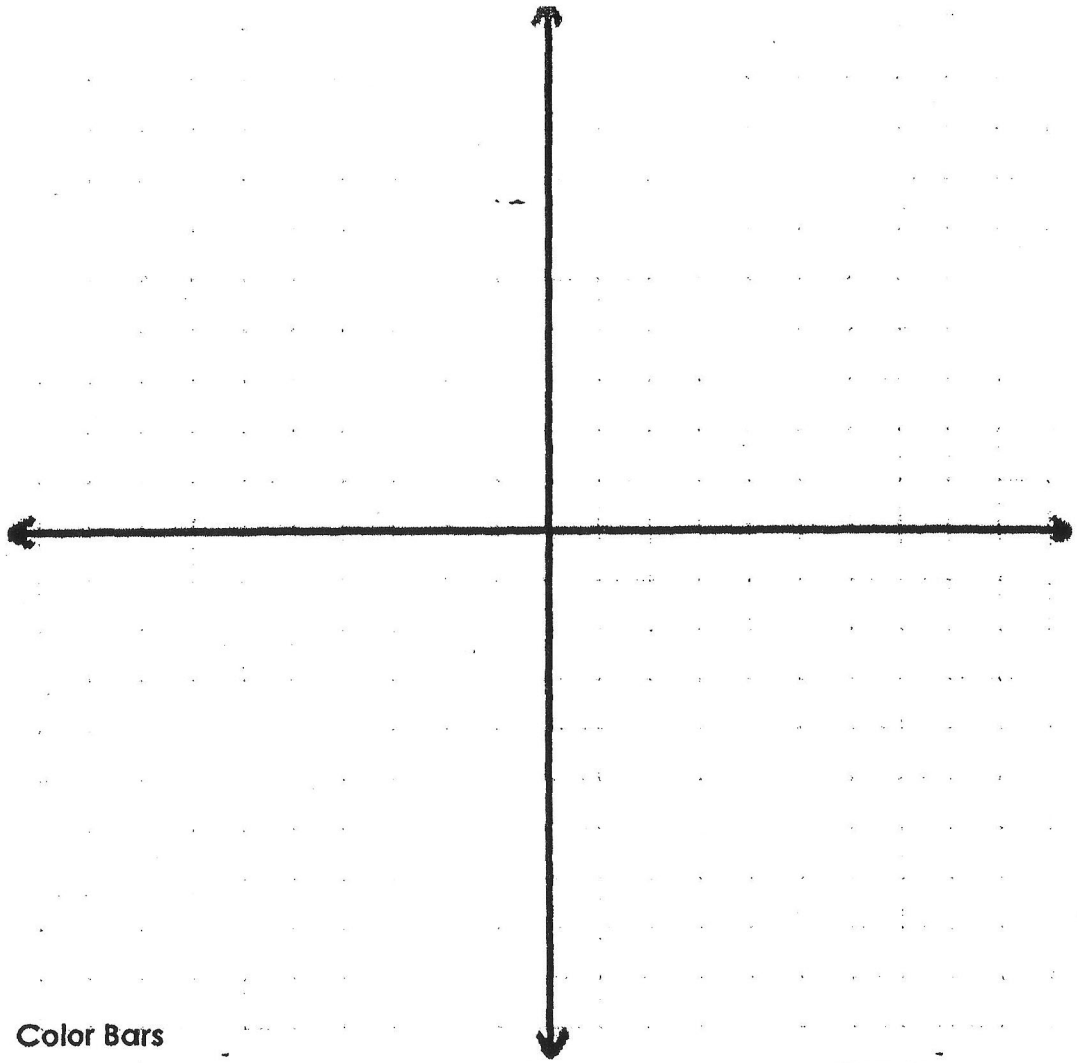
Symmetries?		
y-axis	Yes	No
Y=x	Yes	No
Origin	Yes	No

Even? $f(x) = f(-x)$	Yes	No
Odd? $f(x) = -f(-x)$	Yes	No

Periodic?	Yes: Period=	No
One-to-One?	Yes	No
Onto?	Yes	No

Discontinuities?		
Removable	Undefined	$\pm\infty$

Asymptotes?	
Horizontal $\lim_{x\to\infty} f(x)$	
Horizontal $\lim_{x\to-\infty} f(x)$	
Vertical $\lim_{x\to a} f(x)$	
Oblique (equation)	



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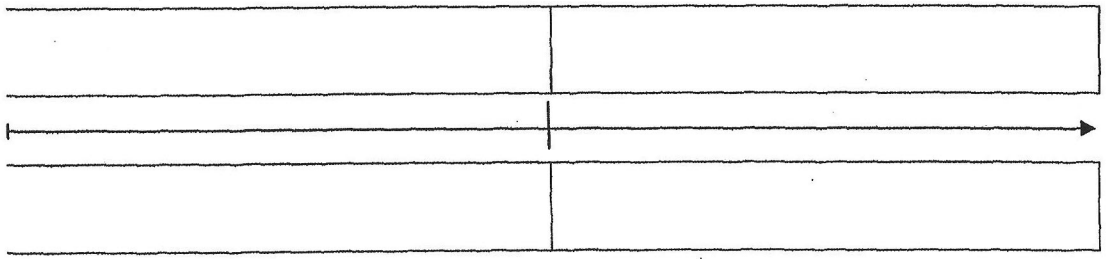
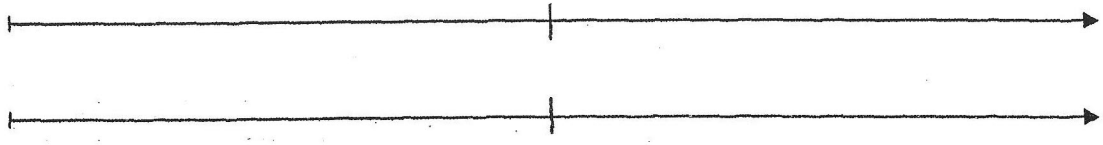


Mapping



Function: _____

Table of Values

X	
Y	

	Interval	Absolute Value	Name
Domain			
Range			

Roots(List)	**Y-Intercept**

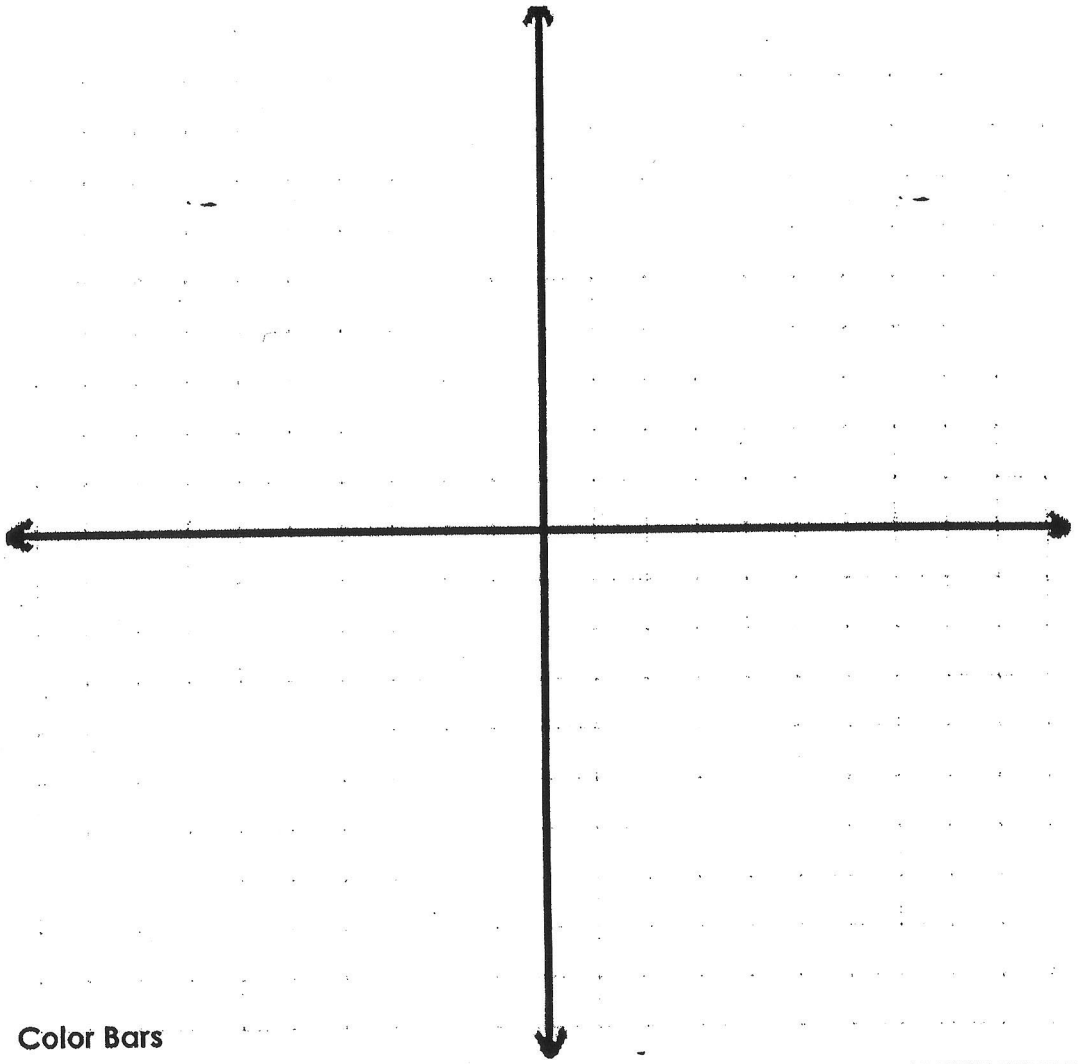
Symmetries?		
y-axis	Yes	No
Y=x	Yes	No
Origin	Yes	No

Even? $f(x) = f(-x)$	Yes	No
Odd? $f(x) = -f(-x)$	Yes	No

Periodic?	Yes: Period= _	No
One-to-One?	Yes	No
Onto?	Yes	No

Discontinuities?		
Removable	Undefined	$\pm\infty$

Asymptotes?	
Horizontal $\lim_{x\to\infty} f(x)$	
Horizontal $\lim_{x\to-\infty} f(x)$	
Vertical $\lim_{x\to a} f(x)$	
Oblique (equation)	



Color Bars

Mapping

Function: _____

Table of Values

X	
Y	

	Interval	Absolute Value	Name
Domain			
Range			

Roots(List)	**Y-Intercept**

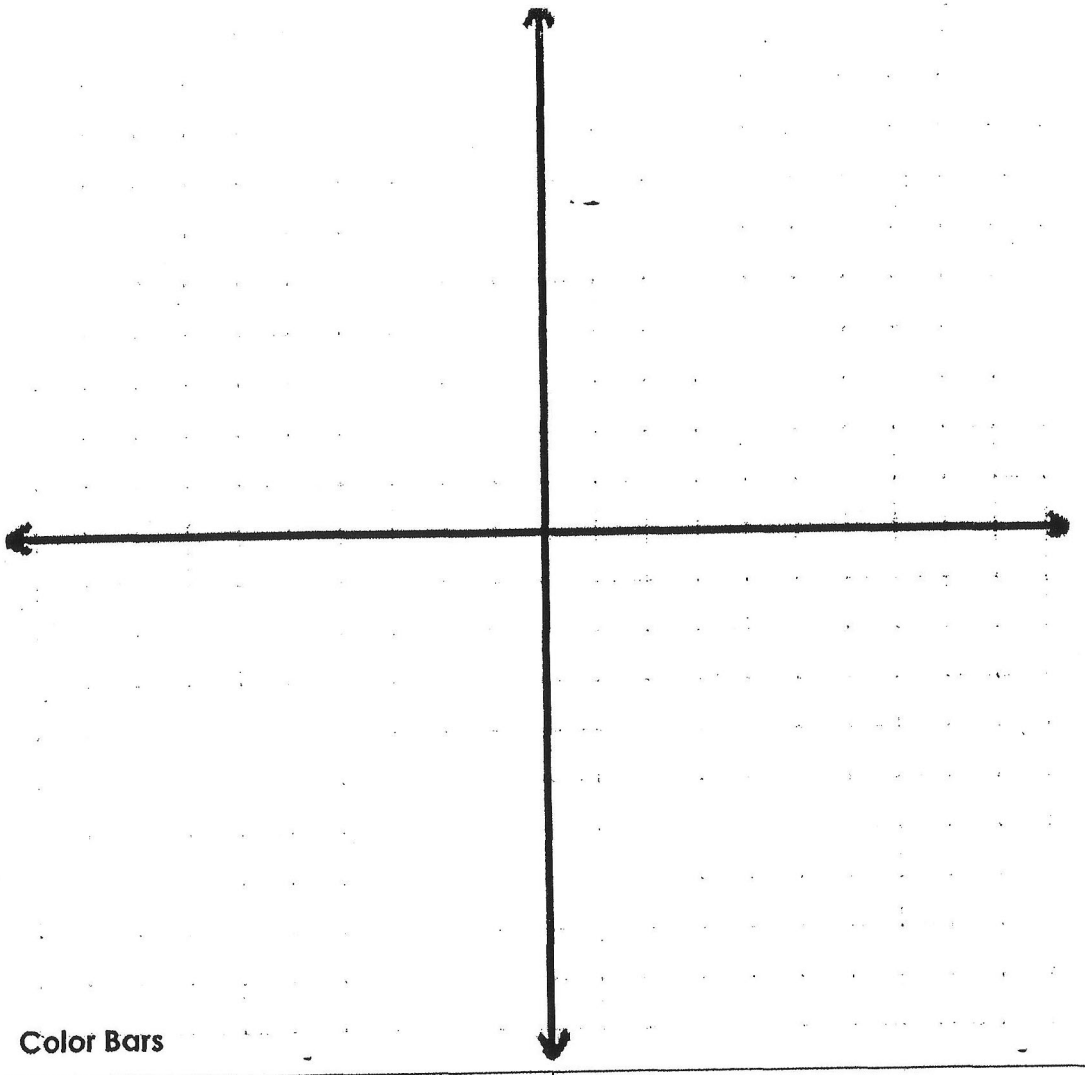
Symmetries?		
y-axis	Yes	No
Y=x	Yes	No
Origin	Yes	No

Even? $f(x) = f(-x)$	Yes	No
Odd? $f(x) = -f(-x)$	Yes	No

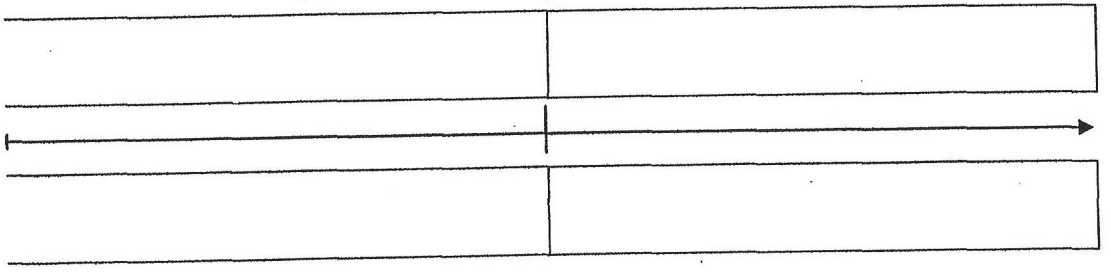
Periodic?	Yes: Period=	No
One-to-One?	Yes	No
Onto?	Yes	No

Discontinuities?		
Removable	Undefined	$\pm\infty$

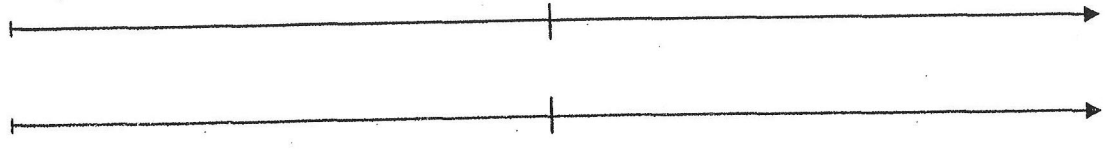
Asymptotes?	
Horizontal $\lim_{x\to\infty} f(x)$	
Horizontal $\lim_{x\to-\infty} f(x)$	
Vertical $\lim_{x\to a} f(x)$	
Oblique (equation)	



Color Bars



Mapping



Function: _____

Table of Values

X	
Y	

	Interval	Absolute Value	Name
Domain			
Range			

Roots(List)	**Y-Intercept**

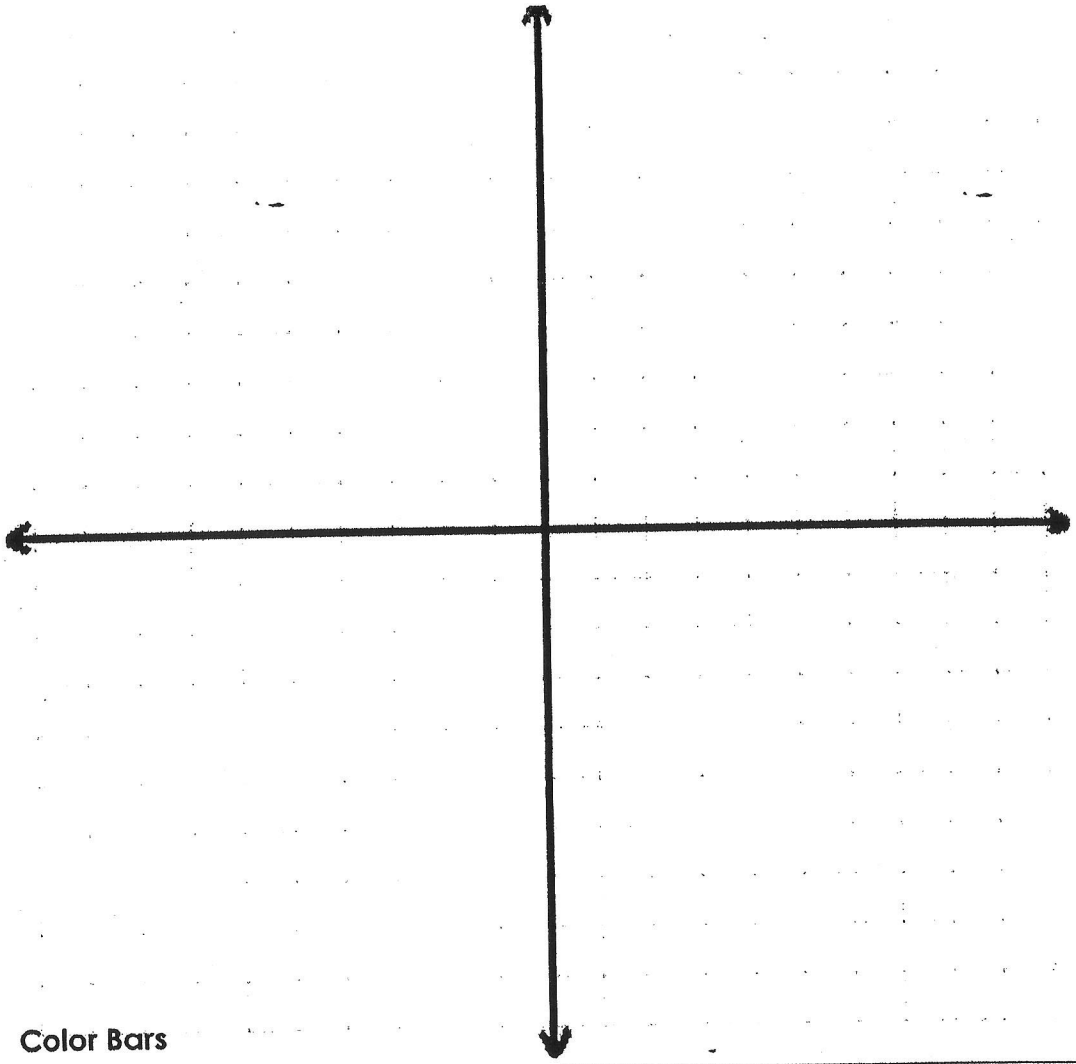
Symmetries?		
y-axis	Yes	No
Y=x	Yes	No
Origin	Yes	No

Even? $f(x) = f(-x)$	Yes	No
Odd? $f(x) = -f(-x)$	Yes	No

Periodic?	Yes: Period=	No
One-to-One?	Yes	No
Onto?	Yes	No

Discontinuities?		
Removable	Undefined	$\pm\infty$

Asymptotes?	
Horizontal $\lim_{x\to\infty} f(x)$	
Horizontal $\lim_{x\to-\infty} f(x)$	
Vertical $\lim_{x\to a} f(x)$	
Oblique (equation)	



Color Bars

Mapping

Function: _____

Table of Values

X	
Y	

	Interval	Absolute Value	Name
Domain			
Range			

Roots(List)	**Y-Intercept**

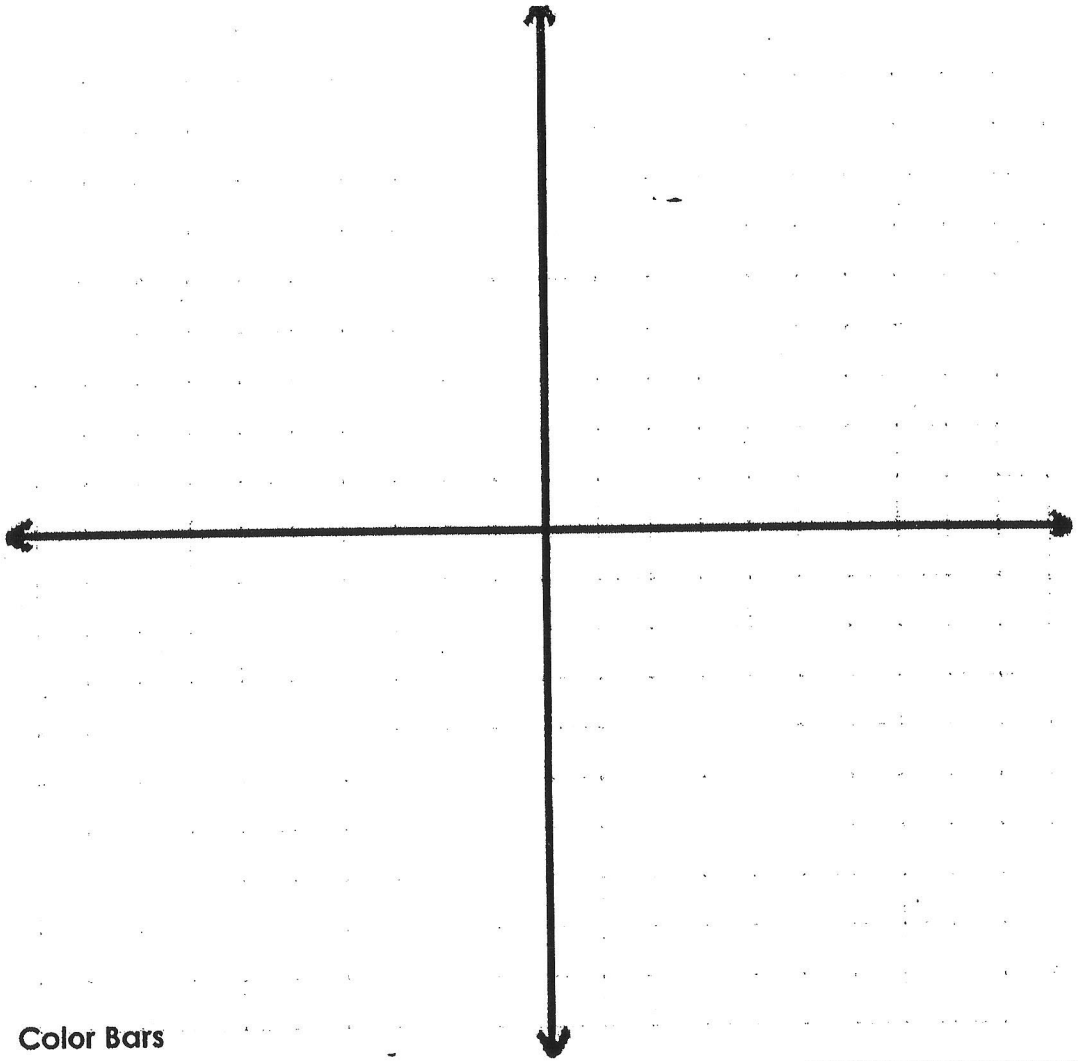
Symmetries?		
y-axis	Yes	No
Y=x	Yes	No
Origin	Yes	No

Even? $f(x) = f(-x)$	Yes	No
Odd? $f(x) = -f(-x)$	Yes	No

Periodic?	Yes: Period=	No
One-to-One?	Yes	No
Onto?	Yes	No

Discontinuities?		
Removable	Undefined	$\pm\infty$

Asymptotes?	
Horizontal $\lim_{x\to\infty} f(x)$	
Horizontal $\lim_{x\to-\infty} f(x)$	
Vertical $\lim_{x\to a} f(x)$	
Oblique (equation)	



Color Bars

Mapping

Function: _____

Table of Values

X	
Y	

	Interval	Absolute Value	Name
Domain			
Range			

Roots(List)	**Y-Intercept**

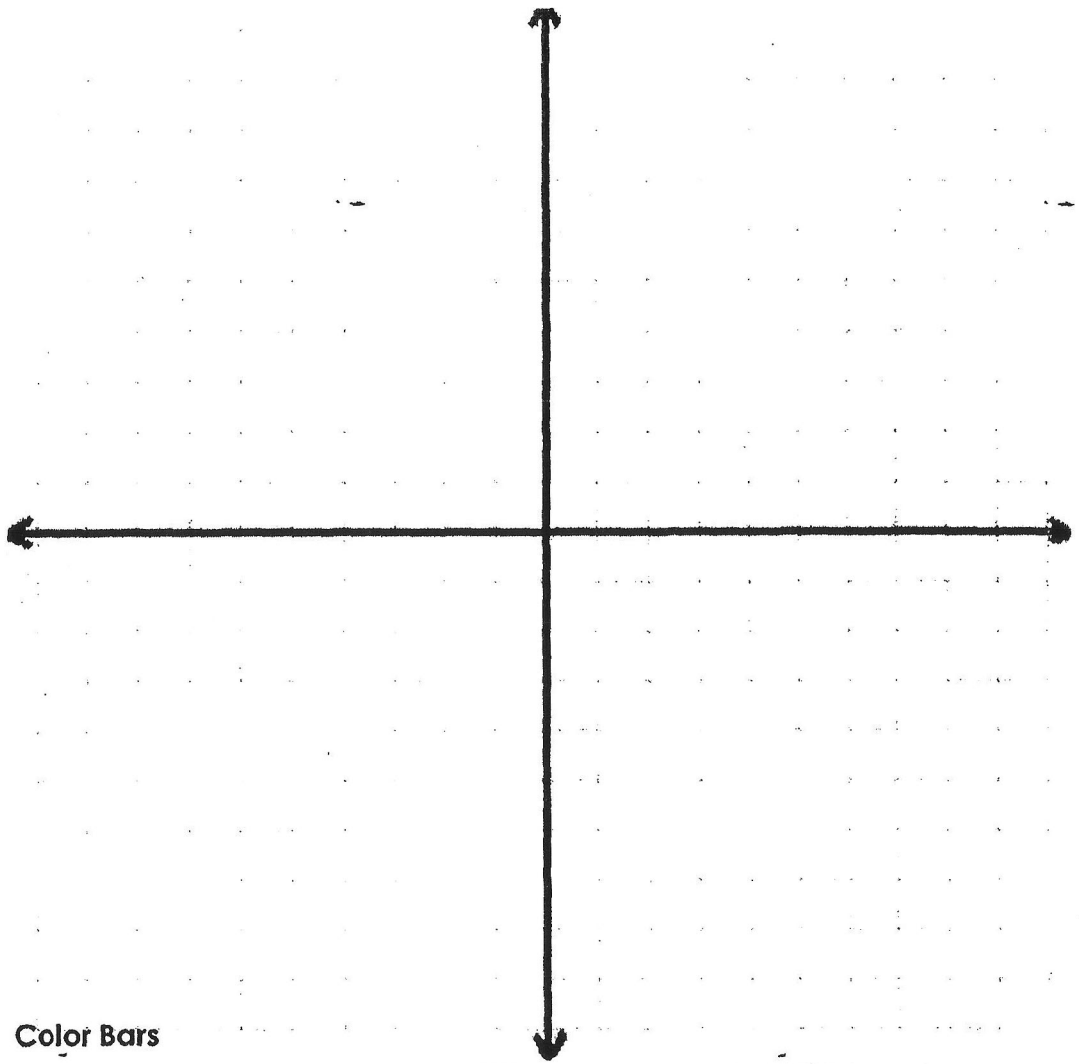
Symmetries?		
y-axis	Yes	No
Y=x	Yes	No
Origin	Yes	No

Even? $f(x) = f(-x)$	Yes	No
Odd? $f(x) = -f(-x)$	Yes	No

Periodic?	Yes: Period=	No
One-to-One?	Yes	No
Onto?	Yes	No

Discontinuities?		
Removable	Undefined	$\pm\infty$

Asymptotes?	
Horizontal $\lim_{x\to\infty} f(x)$	
Horizontal $\lim_{x\to-\infty} f(x)$	
Vertical $\lim_{x\to a} f(x)$	
Oblique (equation)	



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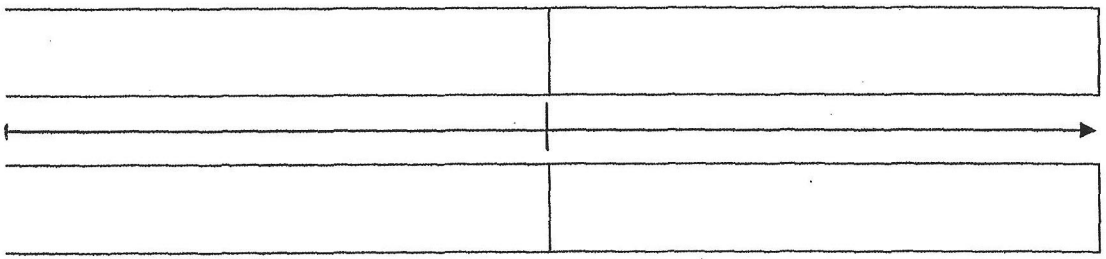

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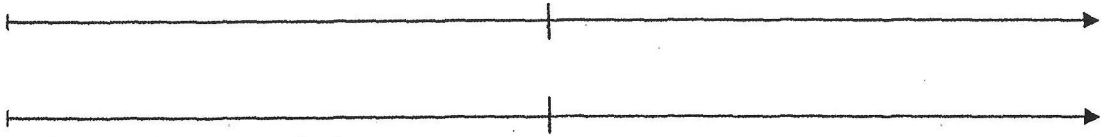


Function: _____

Table of Values

X	
Y	

	Interval	Absolute Value	Name
Domain			
Range			

Roots(List)	**Y-Intercept**

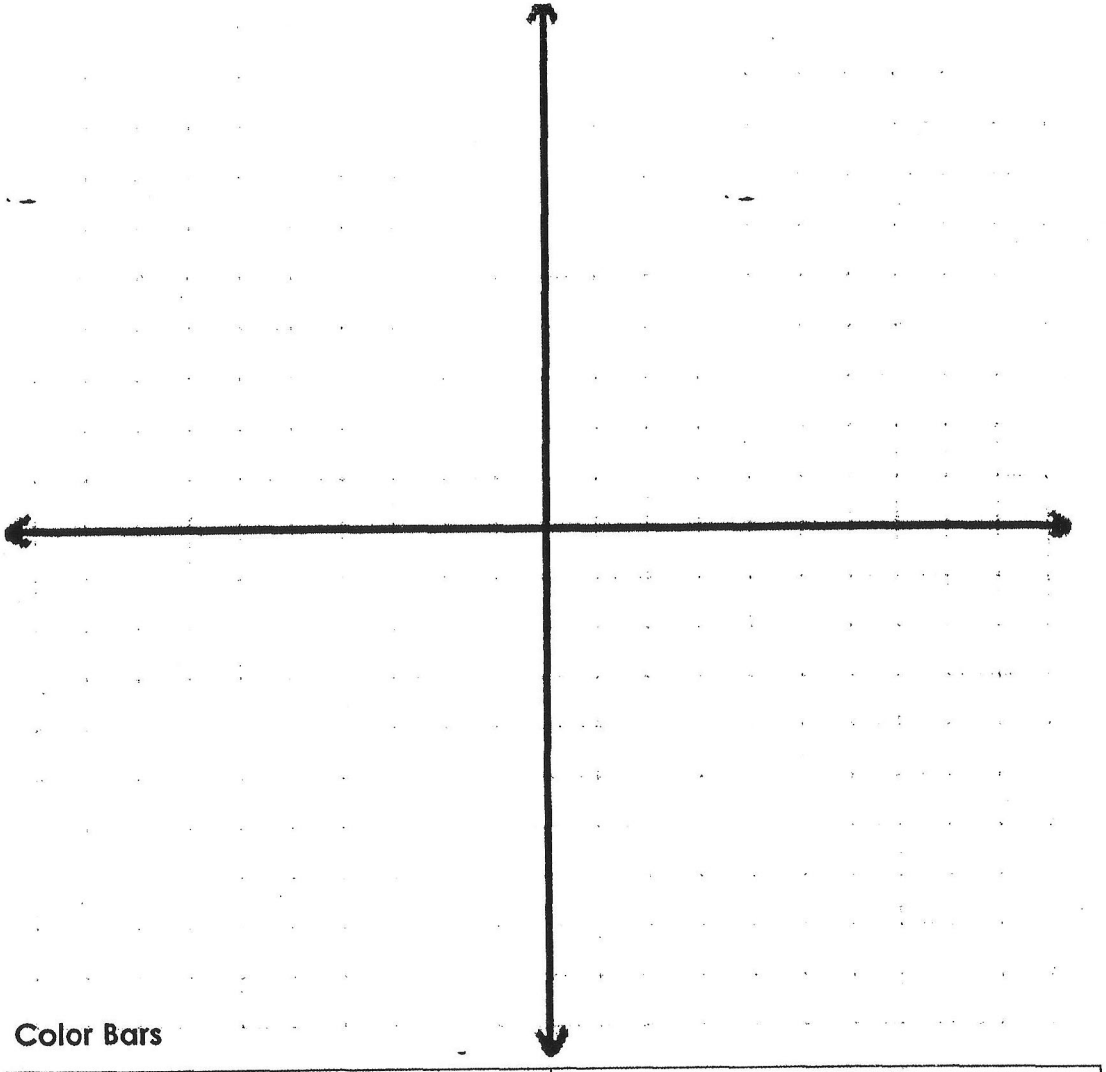
Symmetries?		
y-axis	Yes	No
Y=x	Yes	No
Origin	Yes	No

Even? $f(x) = f(-x)$	Yes	No
Odd? $f(x) = -f(-x)$	Yes	No

Periodic?	Yes: Period=	No
One-to-One?	Yes	No
Onto?	Yes	No

Discontinuities?		
Removable	Undefined	$\pm\infty$

Asymptotes?	
Horizontal $\lim_{x\to\infty} f(x)$	
Horizontal $\lim_{x\to-\infty} f(x)$	
Vertical $\lim_{x\to a} f(x)$	
Oblique (equation)	



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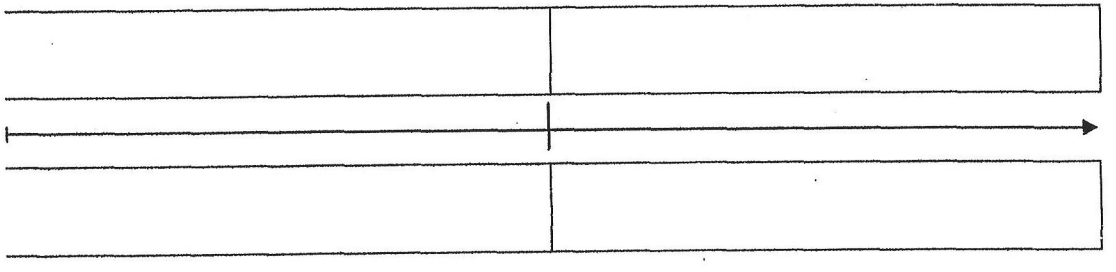
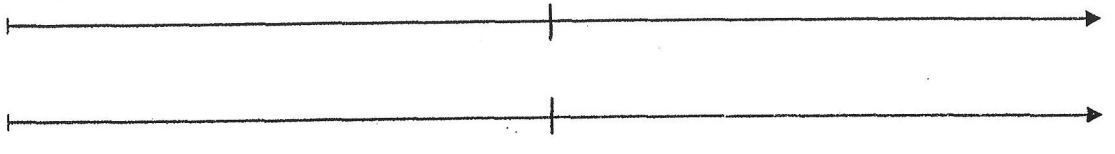


Mapping



Function: _____

Table of Values

X	
Y	

	Interval	Absolute Value	Name
Domain			
Range			

Roots(List)	**Y-Intercept**

Symmetries?		
y-axis	Yes	No
Y=x	Yes	No
Origin	Yes	No

Even? $f(x) = f(-x)$	Yes	No
Odd? $f(x) = -f(-x)$	Yes	No

Periodic?	Yes: Period=	No
One-to-One?	Yes	No
Onto?	Yes	No

Discontinuities?		
Removable	Undefined	$\pm\infty$

Asymptotes?	
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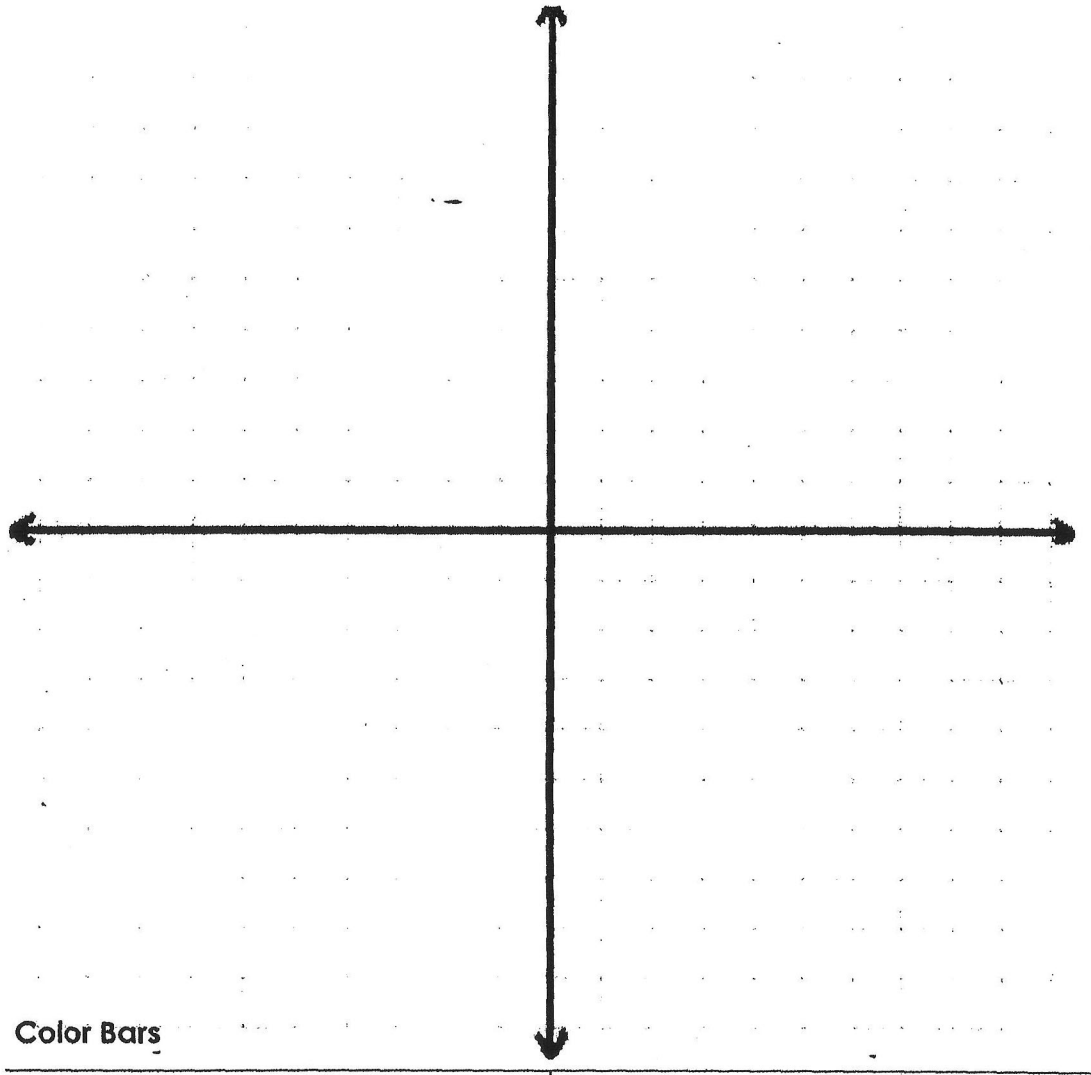

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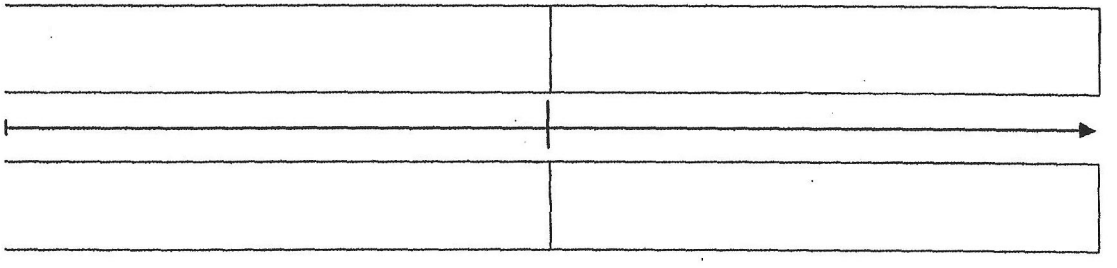

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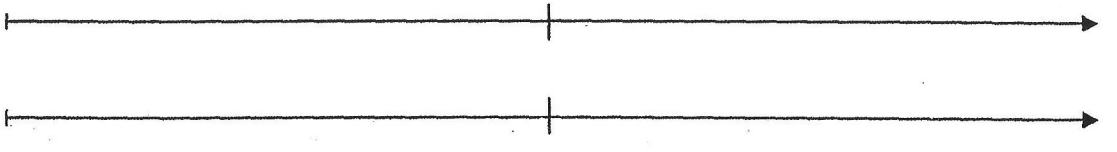

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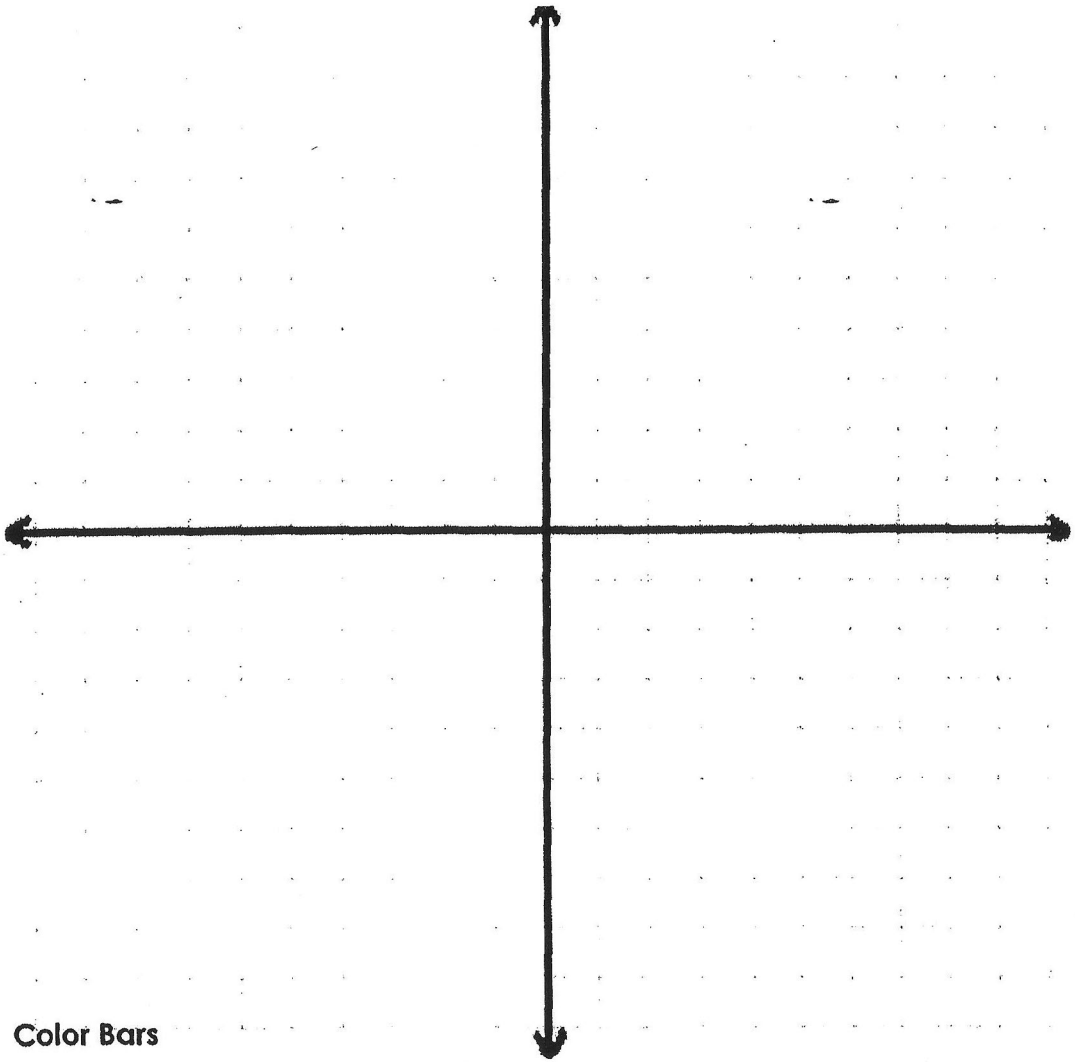

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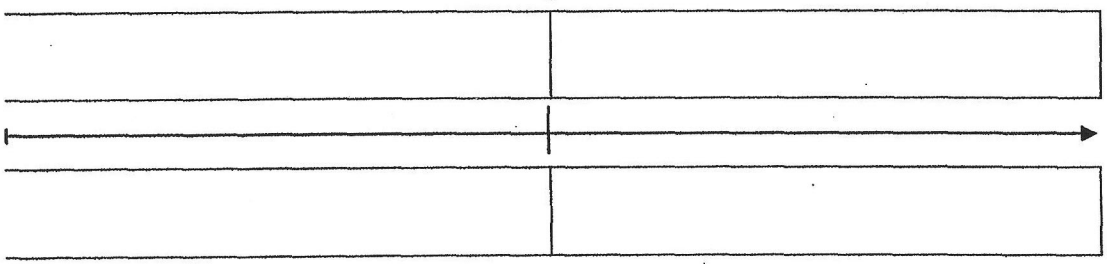

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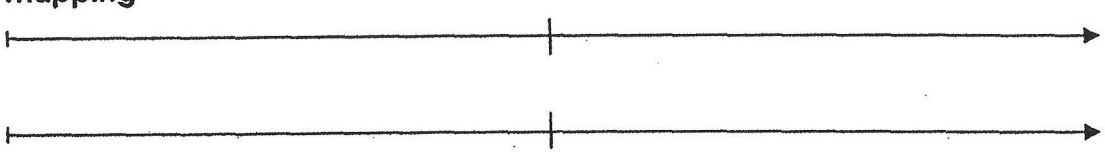

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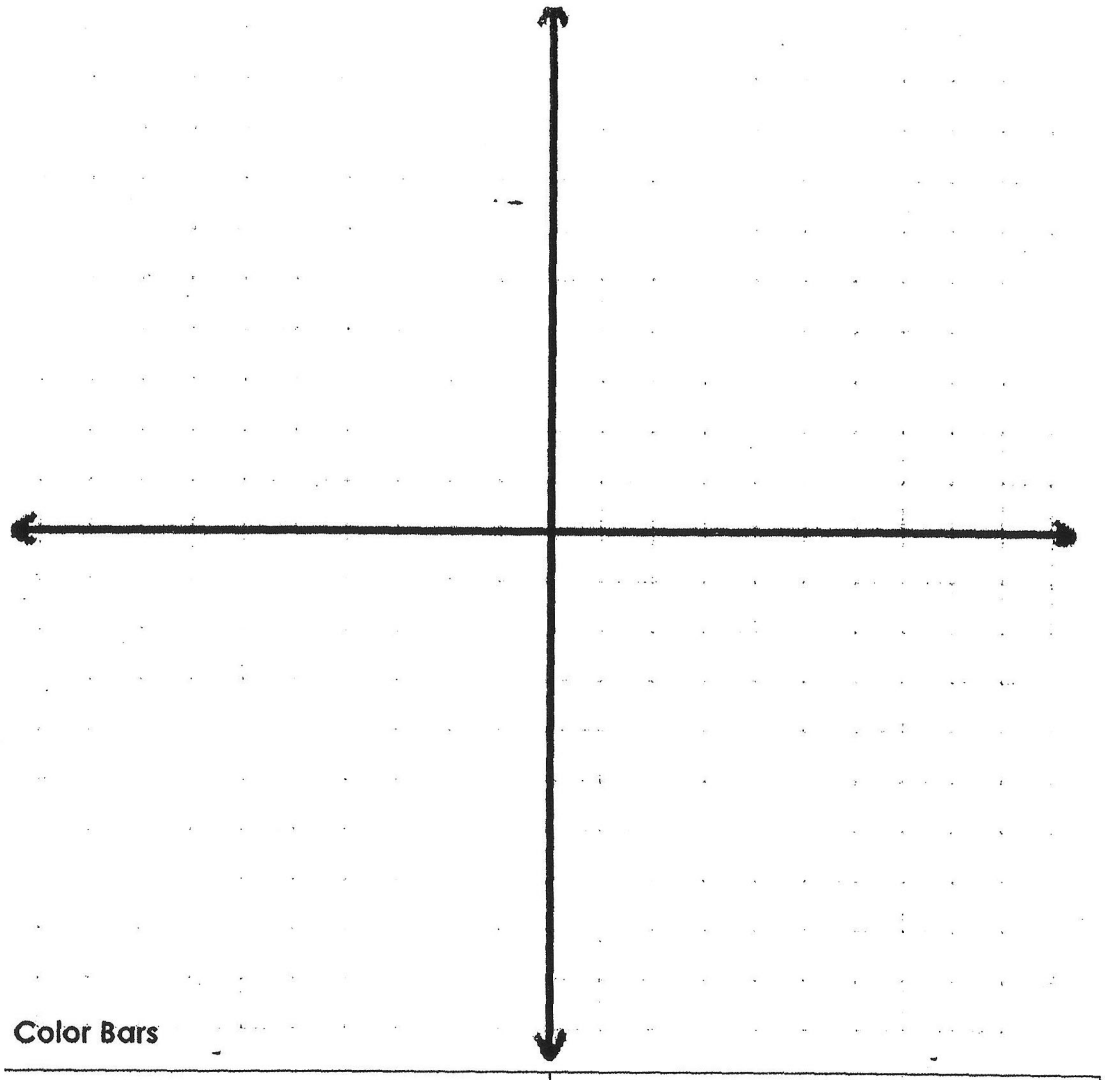

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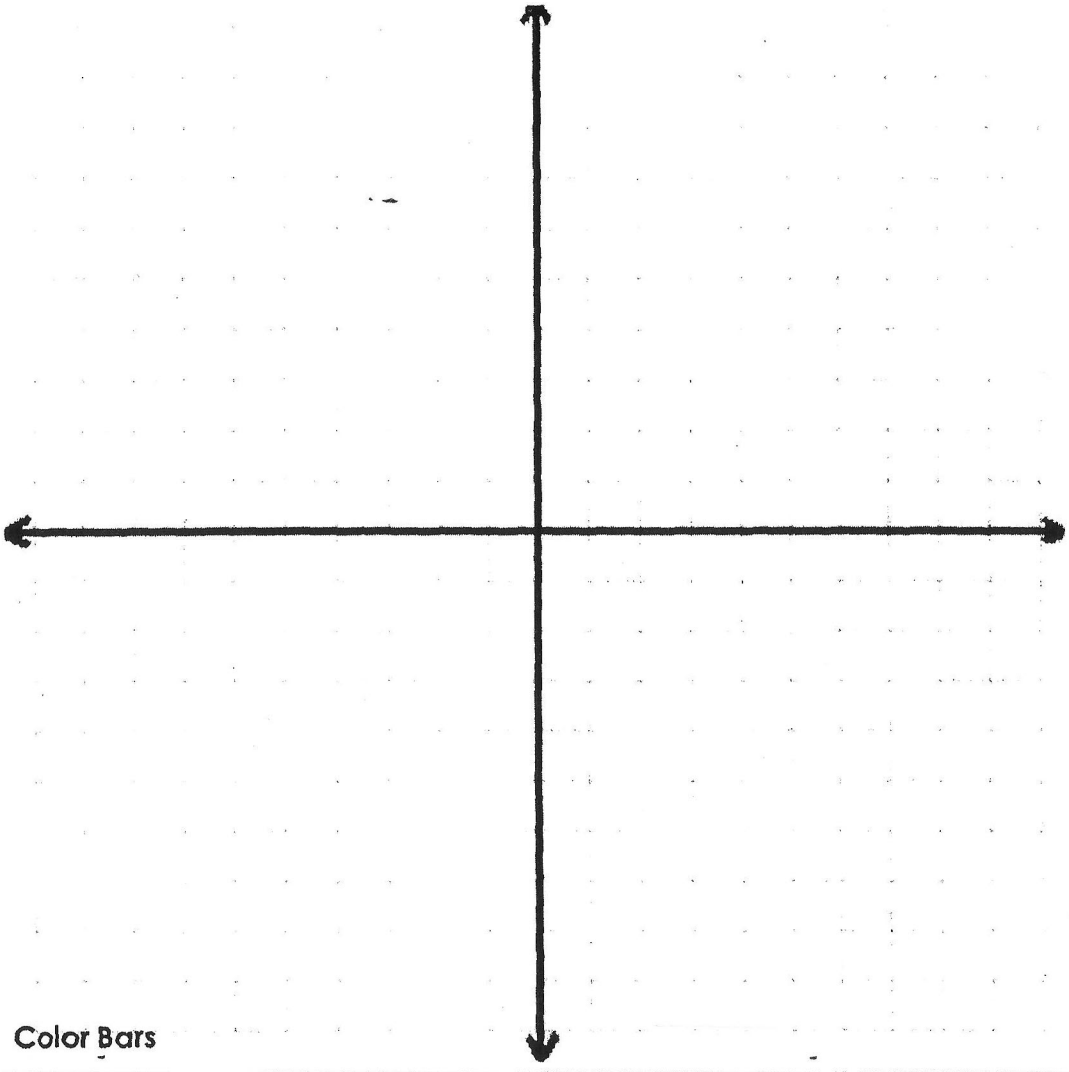

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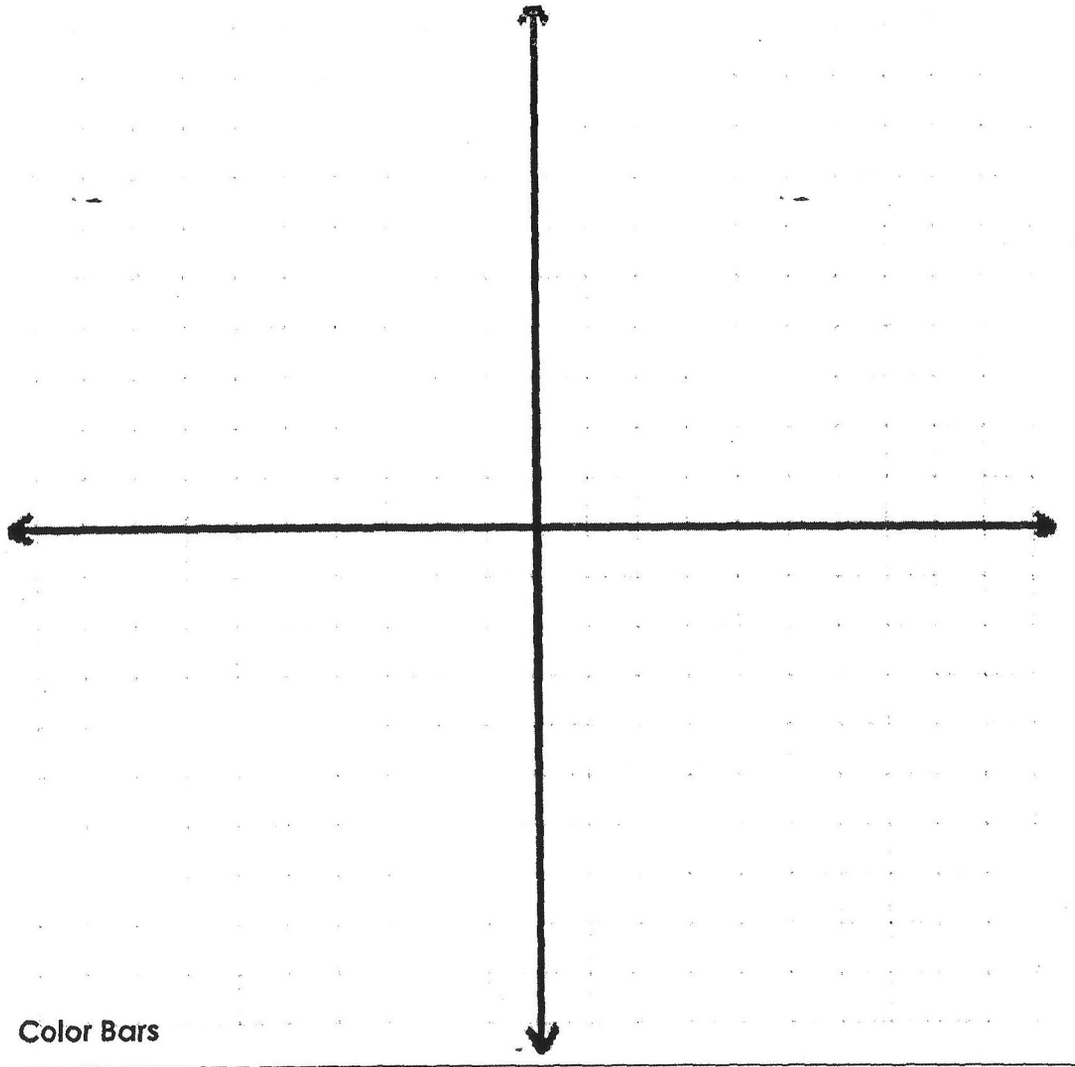

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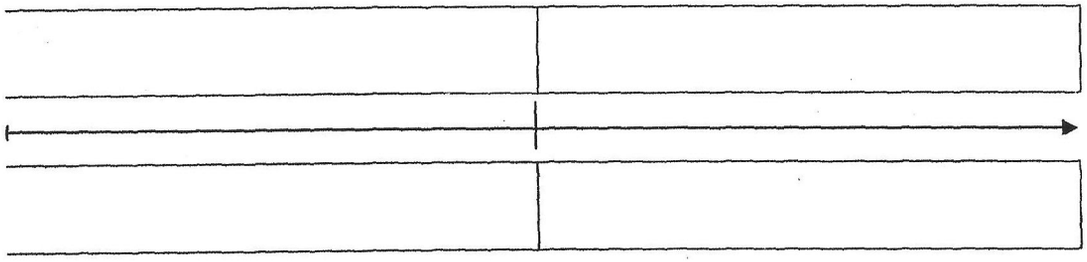

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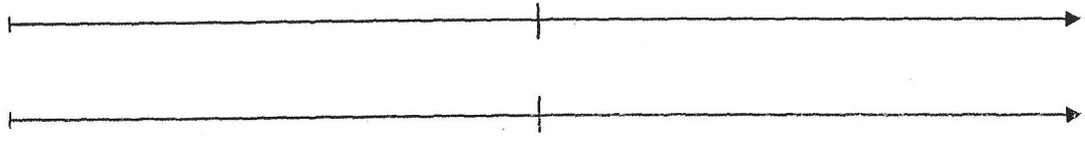

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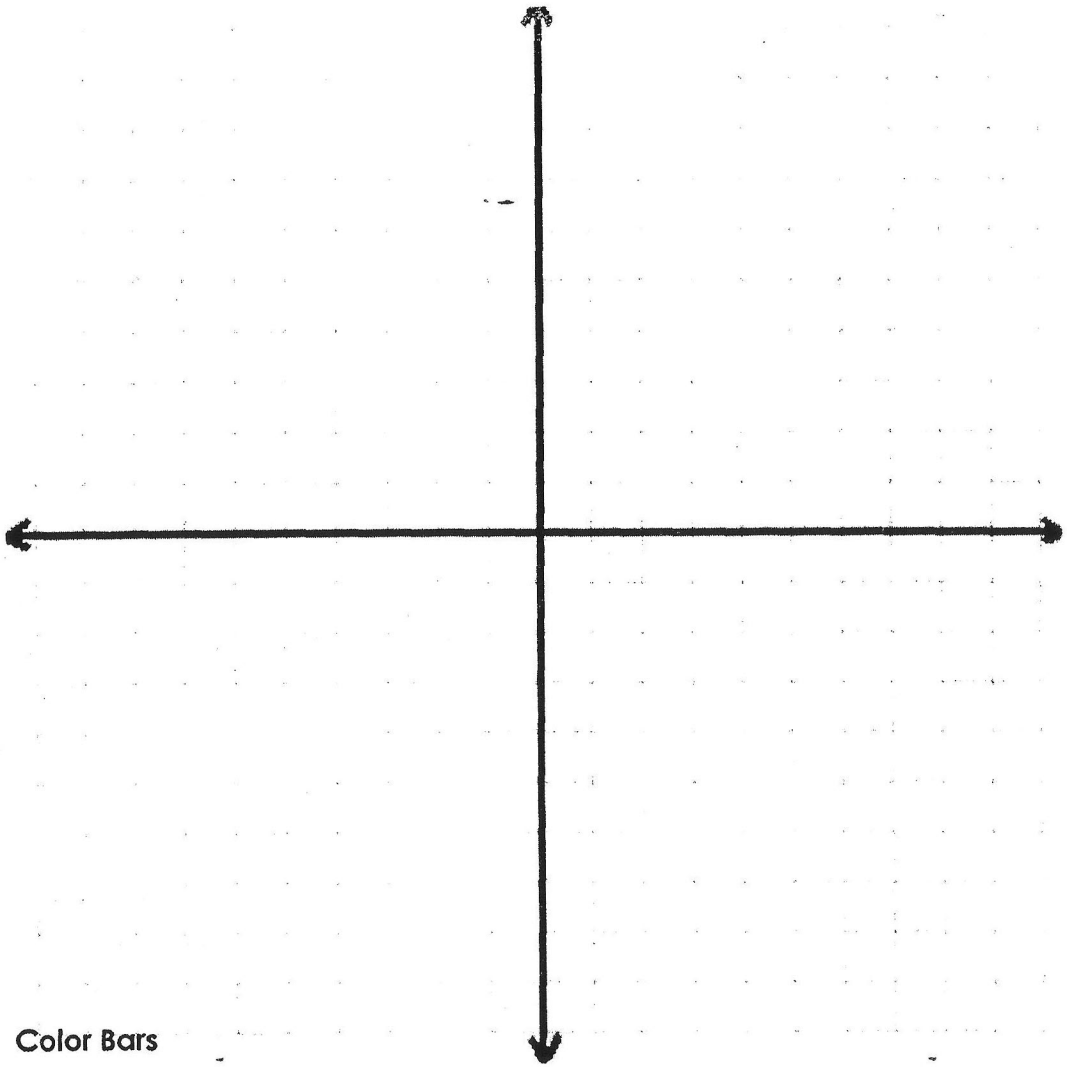

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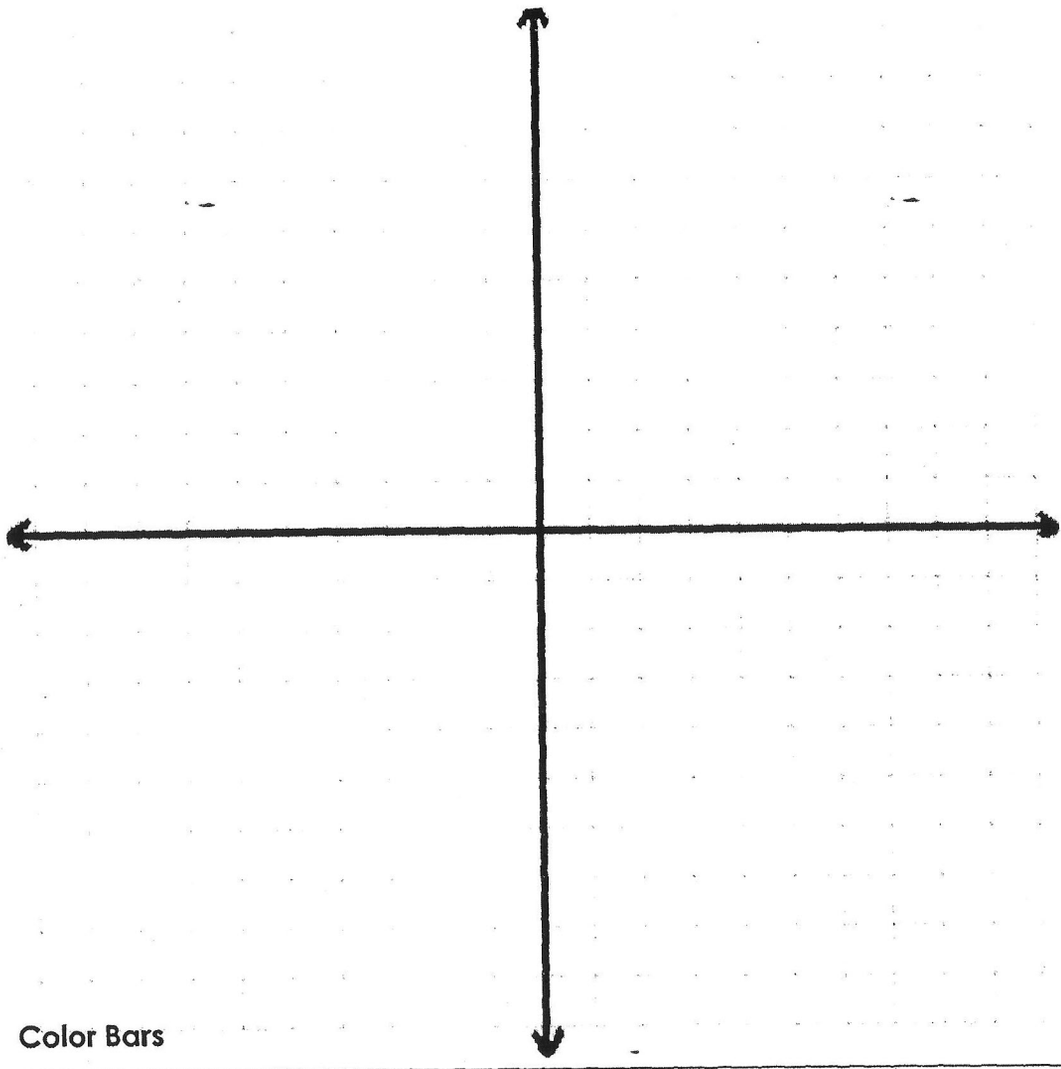

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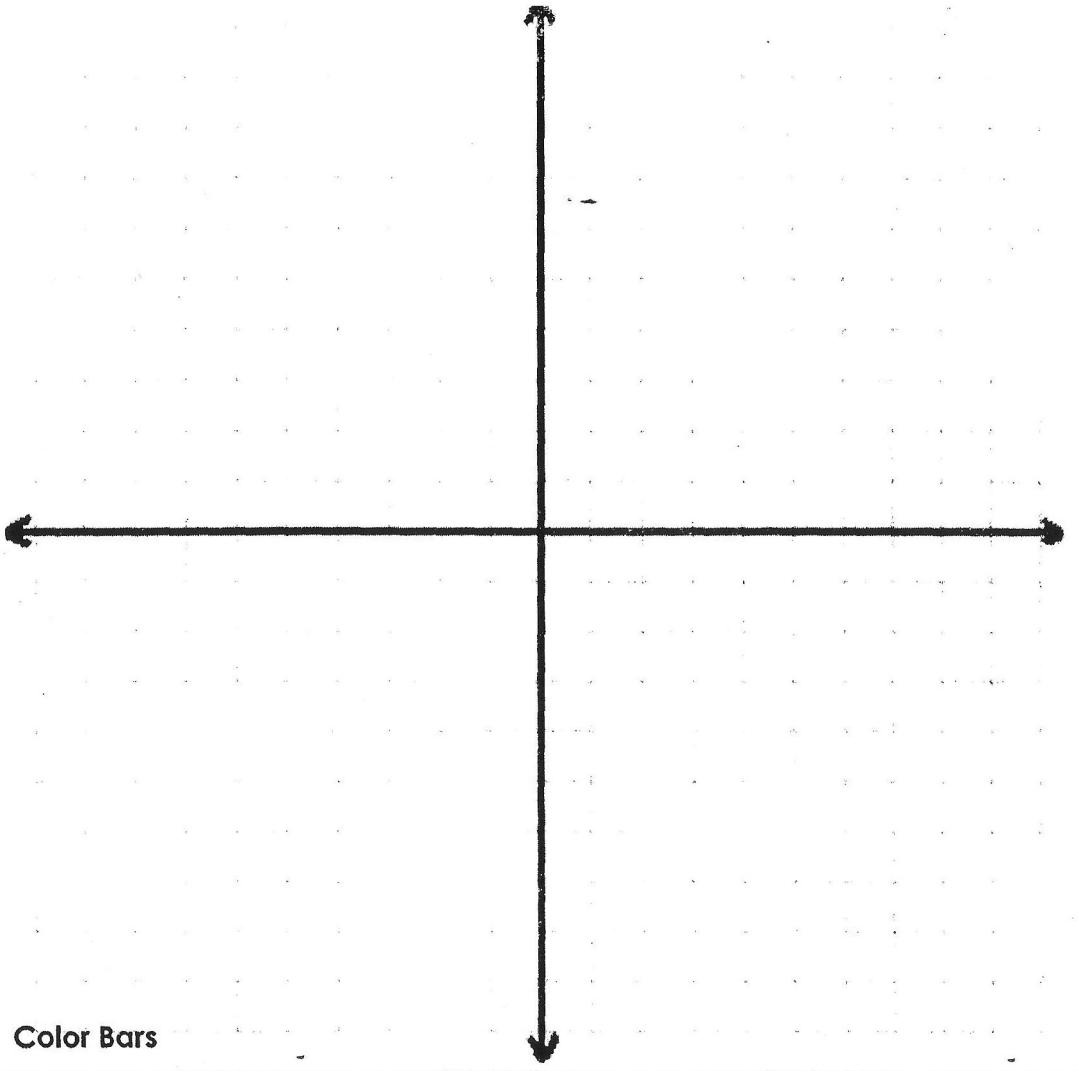

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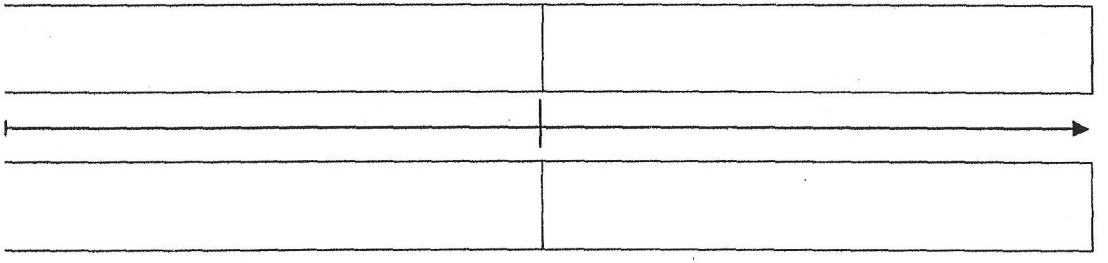

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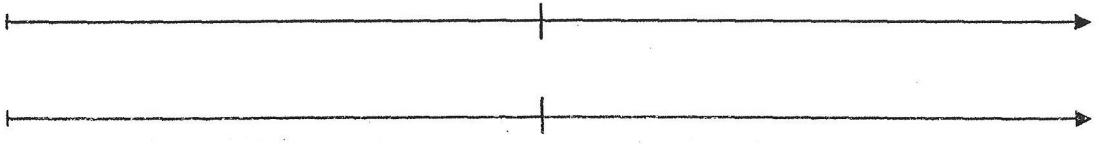

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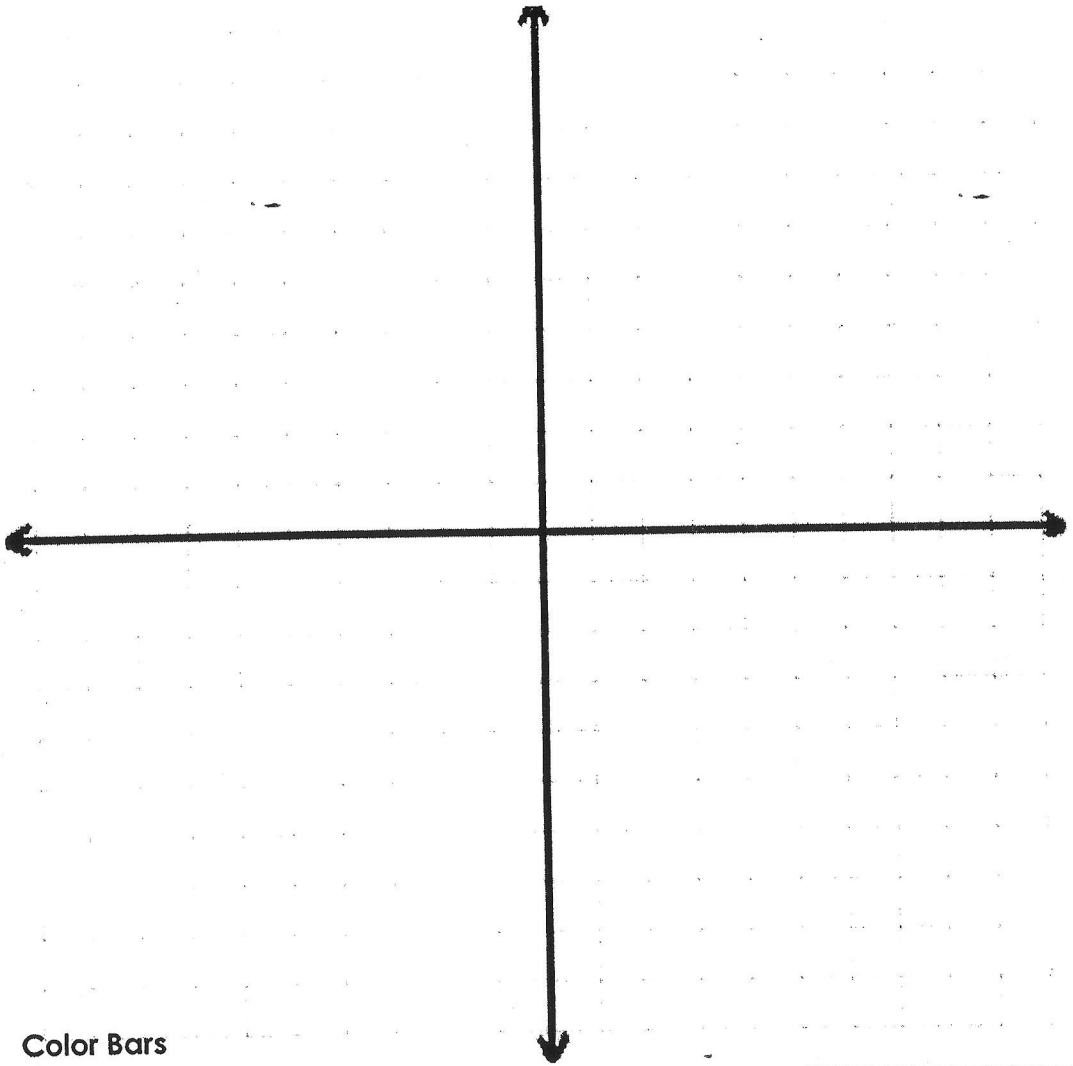

Color Bars

Mapping

Function: _____

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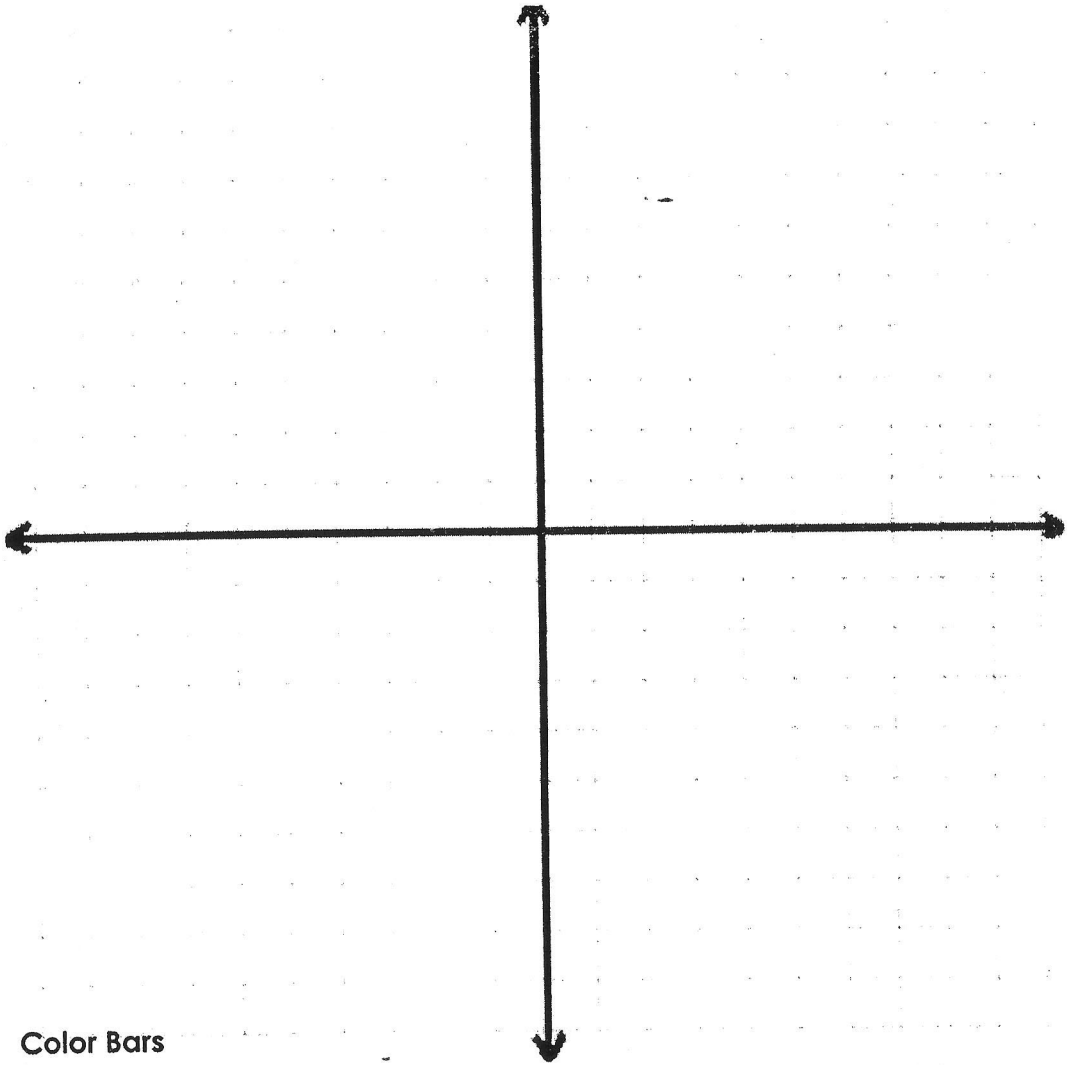

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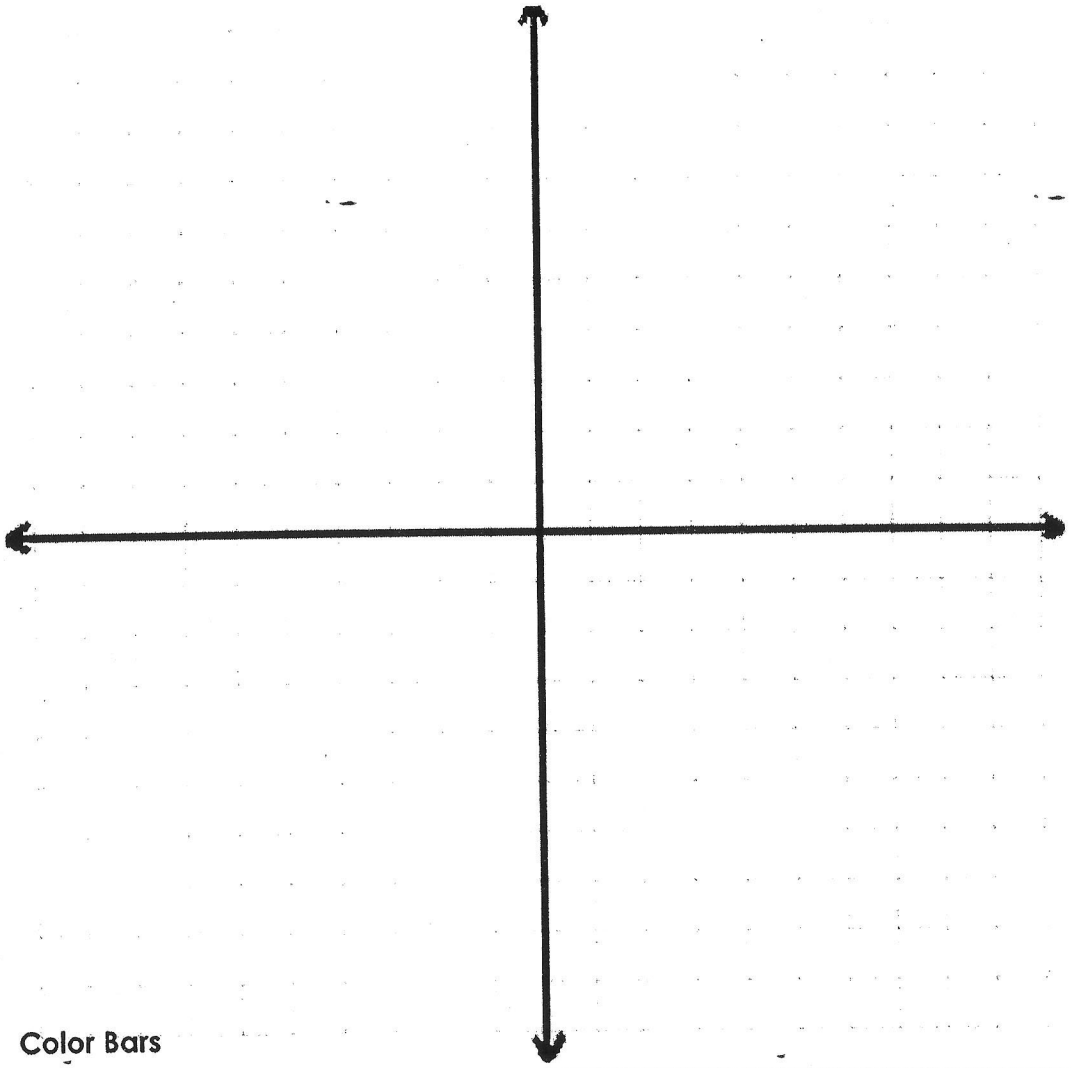

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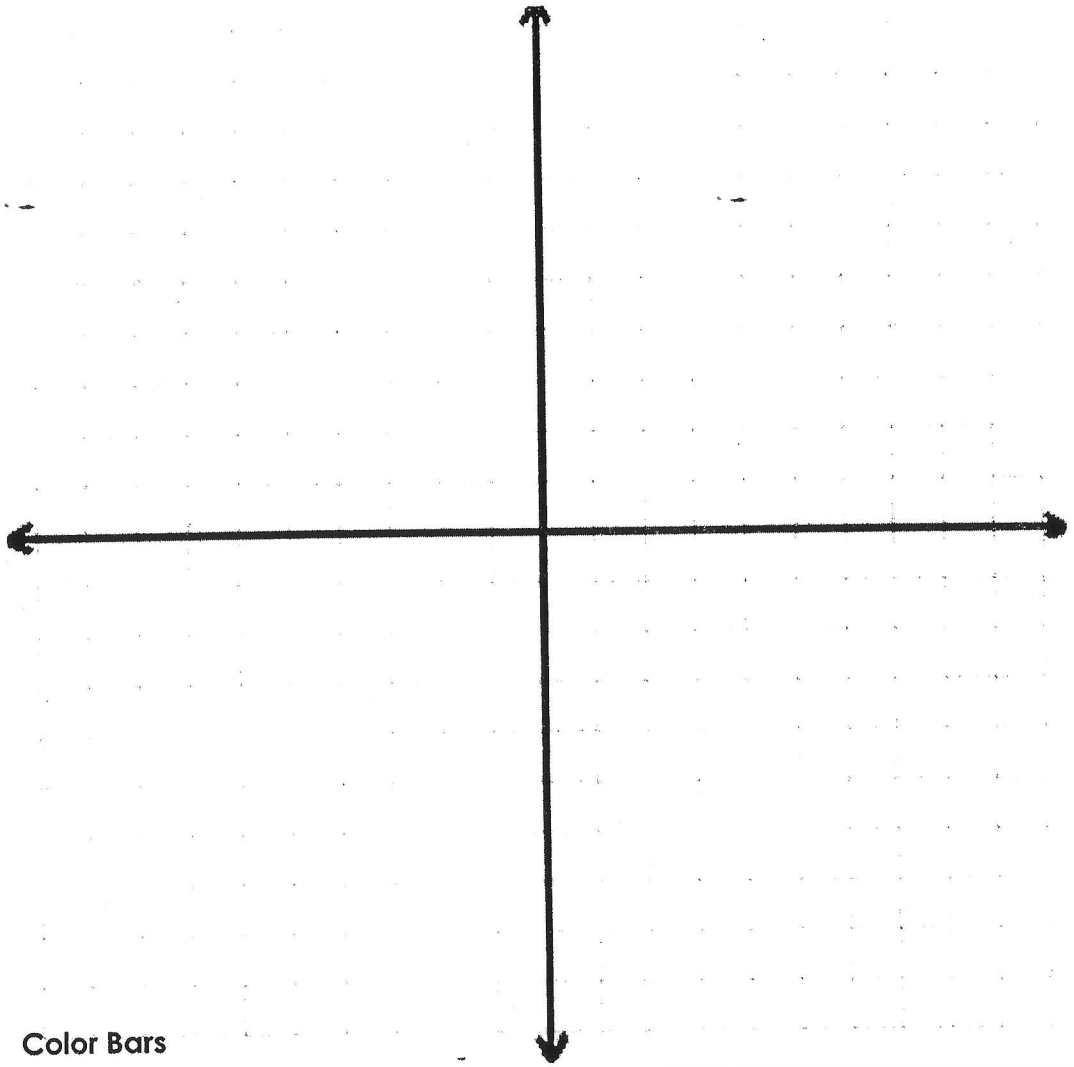

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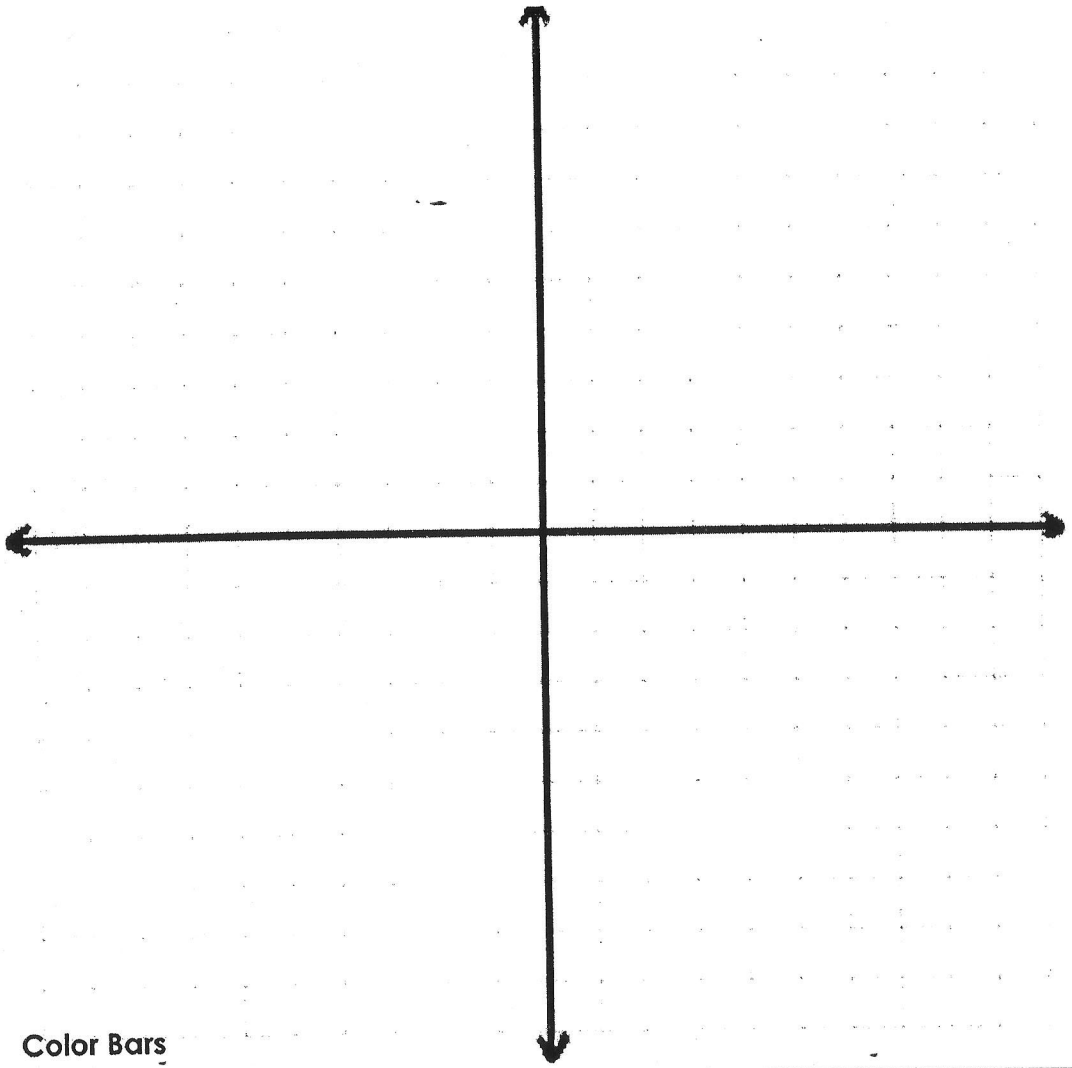

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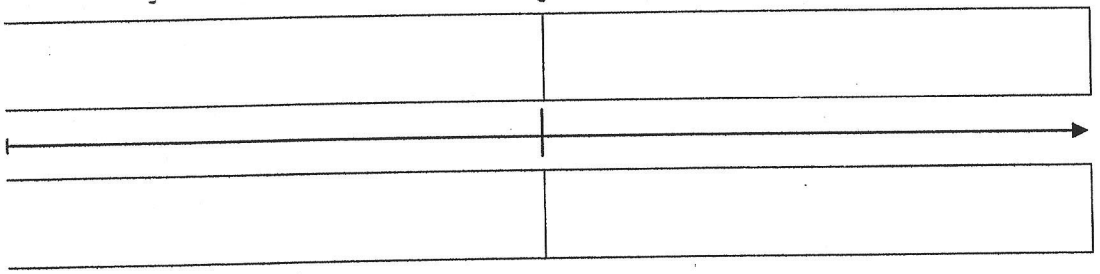

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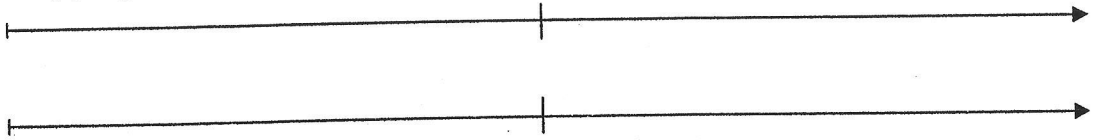

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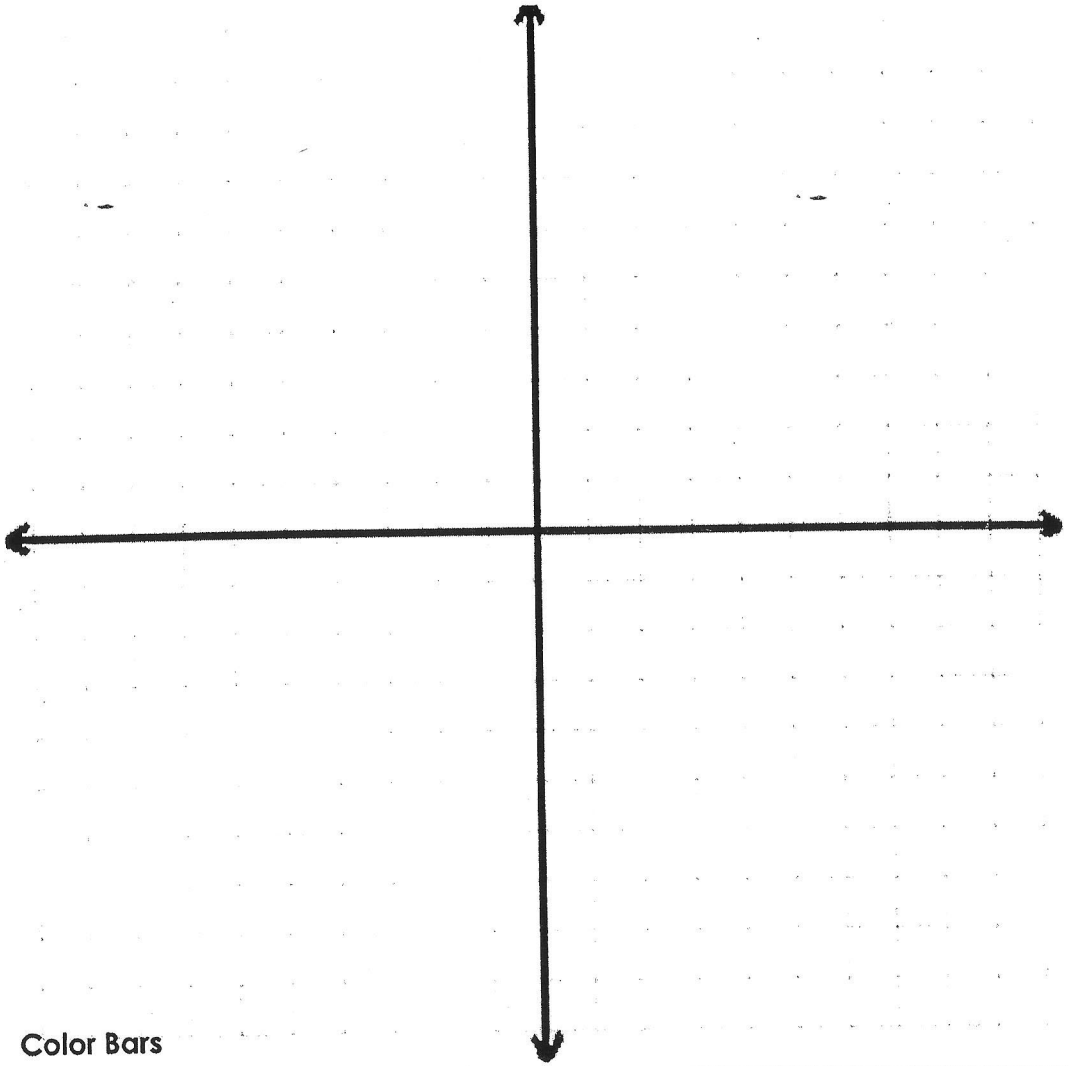

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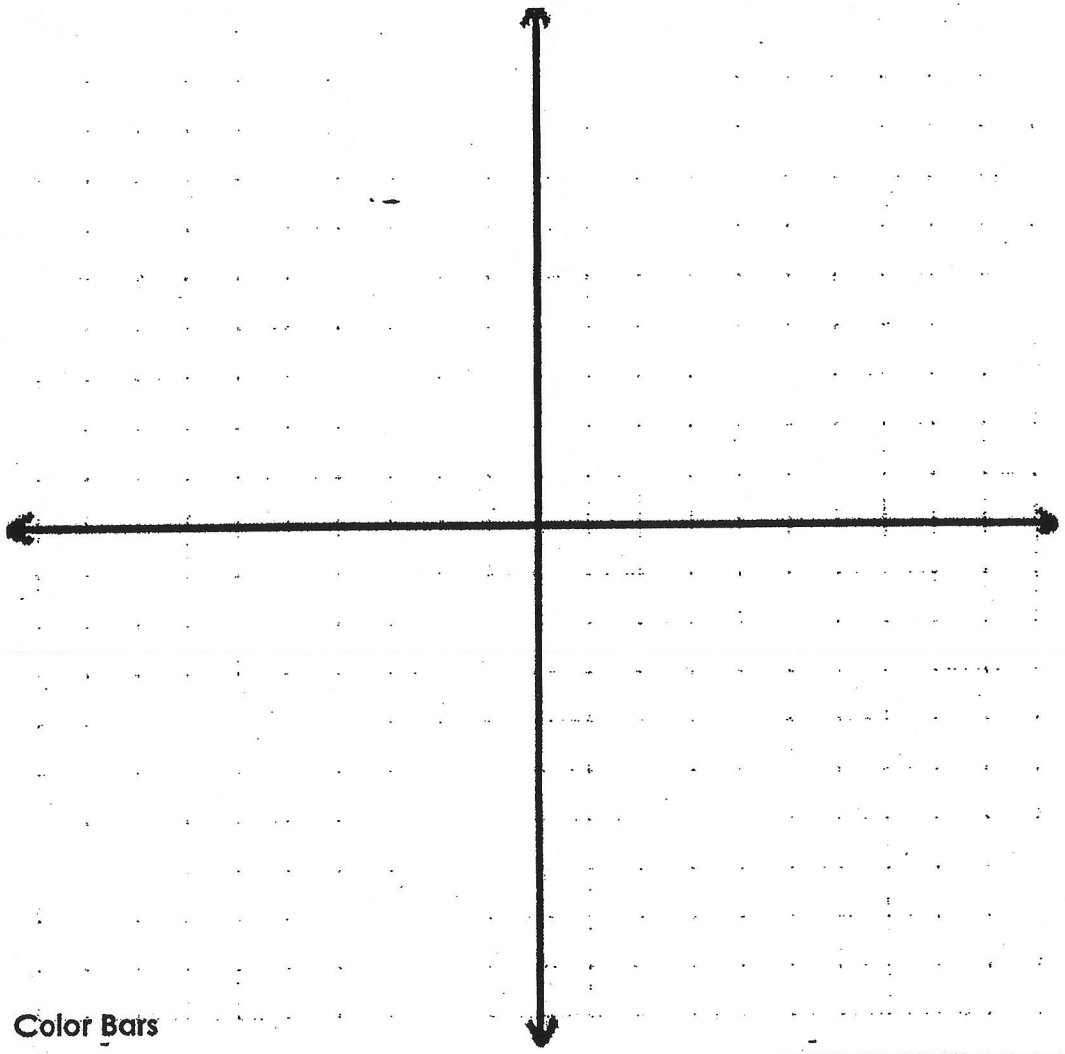

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