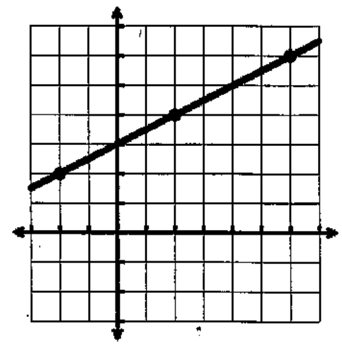
Functions—Rate of change

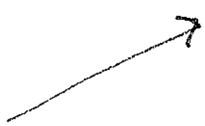
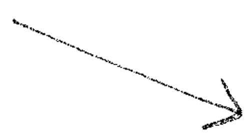
Procedures to Know:

<table>
<tr><th>Function Notation</th><th>Table of f(x)= x+3</th><th>Graph of $f(x)=\frac{1}{2}x+3$</th></tr>
<tr><td>$f(x) = x + 3$</td><td><table><tr><th>x</th><th>f(x)</th></tr><tr><td>0</td><td>3</td></tr><tr><td>2</td><td>5</td></tr><tr><td>4</td><td>7</td></tr><tr><td>6</td><td>9</td></tr></table></td><td></td></tr>
<tr><td>$f(2) =$ 5</td><td>$f(2) =$ 5</td><td>$f(2) =$ 4</td></tr>
</table>

- Evaluating a function: Finding the output or the value of f(x) when given an input.
- Solving for X: Finding the input, or x-value, when given the output, or the function value at x.

Characteristics of Functions: RATES of CHANGE

Average Rate of Change: A ratio that describes how one quantity changes as another quantity changes.

Increasing	Decreasing	Zero
		
Positive slope	Negative slope	Zero slope
Example: f(x)= $4x - 8$	Example: $g(x)= -\frac{1}{2}x+7$	Example: f(x)= 3

Characteristics of Linear Functions

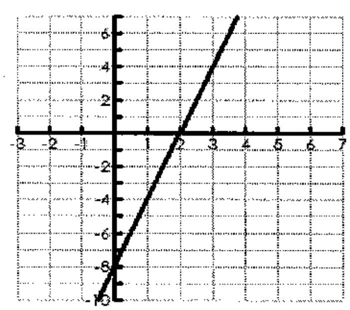
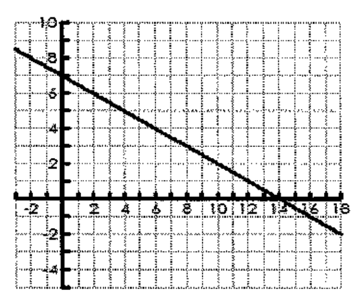
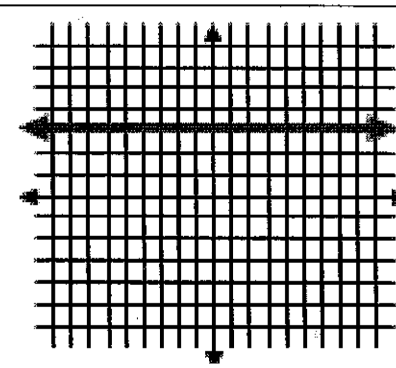
Linear *functions* have a constant rate of change, meaning values increase or decrease at the same rate over a period of time. We know it as slope, which measures how y changes in relationship to x in a linear equation.

We can use a formula that we used to find slope (also called rise-over-run) to calculate the rate of change of a function.

$$m = \frac{y_2 - y_1}{x_2 - x_1} \quad becomes \quad \frac{f(x_2) - f(x_1)}{x_2 - x_1}$$

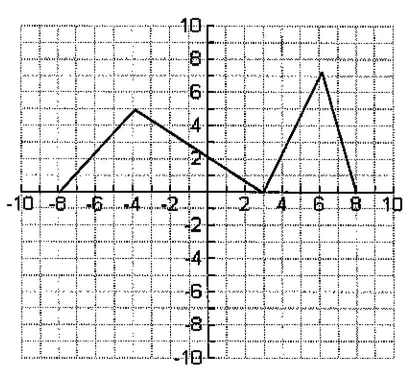
Example 1	Example 2
$f(x) = 2x^2 - 3$ when $x_1 = 2$ *and* $x_2 = 4$ $f(2) = 2(2)^2 - 3 = 2(4) - 3 = 8 - 3 = 5$ $f(4) = 2(4)^2 - 3 = 2(16) - 3 = 32 - 3 = 29$ $\frac{f(x_2) - f(x_1)}{x_2 - x_1} = \frac{29 - 5}{4 - 2} = \frac{24}{2} = 12$	$f(x) = -4x + 10$ when $x_1 = -1$ *and* $x_2 = 3$ $f(-1) = -4(-1) + 10 = 4 + 10 = 14$ $f(3) = -4(3) + 10 = -12 + 10 = -2$ $\frac{f(x_2) - f(x_1)}{x_2 - x_1} = \frac{-2 - 14}{3 - (-1)} = \frac{-16}{4} = -4$

What is the rate of change for the linear function?

$R.O.C =$ 4	$R.O.C =$ $-\frac{1}{2}$	$R.O.C =$ 0
		

How does the **rate of change** relate to the slope of the line?

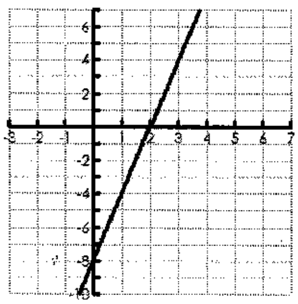
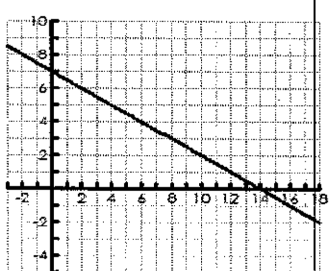
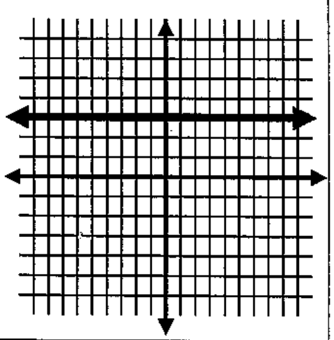
The rate of change is equal to the slope.

	There are four different rates of change in this example. Which area has the greatest (largest) rate of change?

Name: Key Date: ____________

Characteristics of Linear Functions Practice

DIRECTIONS:

<table>
<tr><th>Graph</th><th>Equation</th><th>Table</th><th>Increasing, Decreasing, or zero change</th></tr>
<tr><td></td><td>f(x)= 4x - 8</td><td><table><tr><th>X</th><th>f(x)</th></tr><tr><td>-2</td><td>-16</td></tr><tr><td>0</td><td>-8</td></tr><tr><td>1</td><td>-4</td></tr><tr><td>2</td><td>0</td></tr><tr><td>3</td><td>4</td></tr></table></td><td>increasing</td></tr>
<tr><td></td><td>g(x)= $-\frac{1}{2}x+7$</td><td><table><tr><th>X</th><th>g(x)</th></tr><tr><td>-6</td><td>10</td></tr><tr><td>-4</td><td>9</td></tr><tr><td>-2</td><td>8</td></tr><tr><td>0</td><td>7</td></tr><tr><td>2</td><td>6</td></tr></table></td><td>decreasing</td></tr>
<tr><td></td><td>h(x)= 3</td><td><table><tr><th>X</th><th>h(x)</th></tr><tr><td>-2</td><td>3</td></tr><tr><td>-1</td><td>3</td></tr><tr><td>0</td><td>3</td></tr><tr><td>1</td><td>3</td></tr><tr><td>2</td><td>3</td></tr></table></td><td>zero</td></tr>
</table>

Match **each** of the graphs above to **one** of the linear equations below.

$y = 4x - 8$	$y = 3$	$y = -\frac{1}{2}x + 7$
$y = \frac{1}{2}x + 7$	$x = 3$	$y = \frac{1}{4}x - 8$

$f(x)$	$g(x)$	$h(x)$

What is the rate of change between f(-2) and f(0)? $\frac{f(x_2)-f(x_1)}{x_2-x_1} = \frac{f(0)-f(-2)}{0-(-2)}$ $\frac{-8-(-12)}{0+2} = \frac{-8+16}{2}$ $= \frac{8}{2} = 4$	What is the rate of change between f(-2) and f(0)? $f(x_2)-f(x_1) = \frac{f(0)-f(-2)}{0-(-2)}$ $\frac{7-8}{0-(-2)} = \frac{-1}{2}$	What is the rate of change between f(-2) and f(0)? $\frac{f(x_2)-f(x_1)}{x_2-x_1} = \frac{f(0)-f(-2)}{0-(-2)}$ $\frac{3-3}{0+2} = \frac{0}{2}$ $= \boxed{0}$
What is the rate of change between f(-2) and f(2)? $\frac{f(x_2)-f(x_1)}{x_2-x_1} = \frac{f(2)-f(-2)}{2-(-2)}$ $\frac{0-(-16)}{2+2} = \frac{16}{4} = 4$	What is the rate of change between f(-2) and f(2)? $\frac{f(x_2)-f(x_1)}{x_2-x_1} = \frac{f(2)-f(-2)}{2-(-2)}$ $\frac{6-8}{2+2} = \frac{-2}{4}$ $= \frac{-1}{2}$	What is the rate of change between f(-2) and f(2)? $\frac{f(2)-f(-2)}{2-(-2)} =$ $\frac{3-3}{2+2} = \frac{0}{4}$ $= \boxed{0}$

? What is the rate

what Is the rate of change between f(-2) and f(0)? ~~different than the rate of change between~~ f(-2) and f(2) for your function? Why are these rates of change the same although the distance between the two points are different?

What is the relationship between rate of change in linear functions and the slope of the line?

Name: ______________________________ Date: ____________________

1. Fill in the information for the graph.