

1-1 Key Features of Functions

How to express Intervals

Set Builder Notation

$$y = x^2 - 3$$

$\left\{ \begin{array}{l} \text{Variable} \\ \text{"such that"} \end{array} \middle| \text{inequality} \right\}$

$\{x \mid \mathbb{R}\}$ or $\{x \mid -\infty < x < \infty\}$

$\{y \mid y \geq -3\}$ or $\{y \mid \underline{-3} \leq y < \infty\}$

Interval Notation

Parentheses $(\text{min}, \text{max}]$ Bracket
 if can't reach if can reach

$D: (-\infty, \infty)$ $R: [-3, \infty)$

↑ Domain ↑ Range ↑ $y \geq -3$

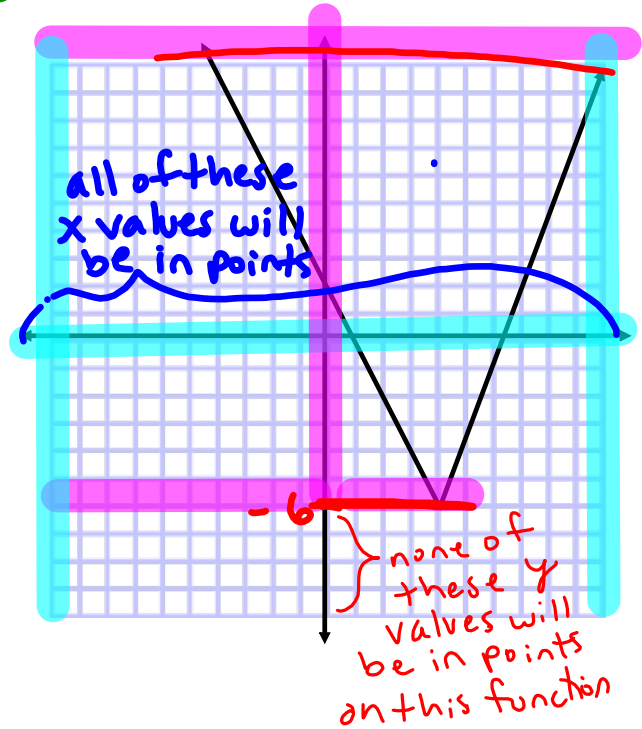
Domain and Range

Domain: what x can and can't be (Inputs)

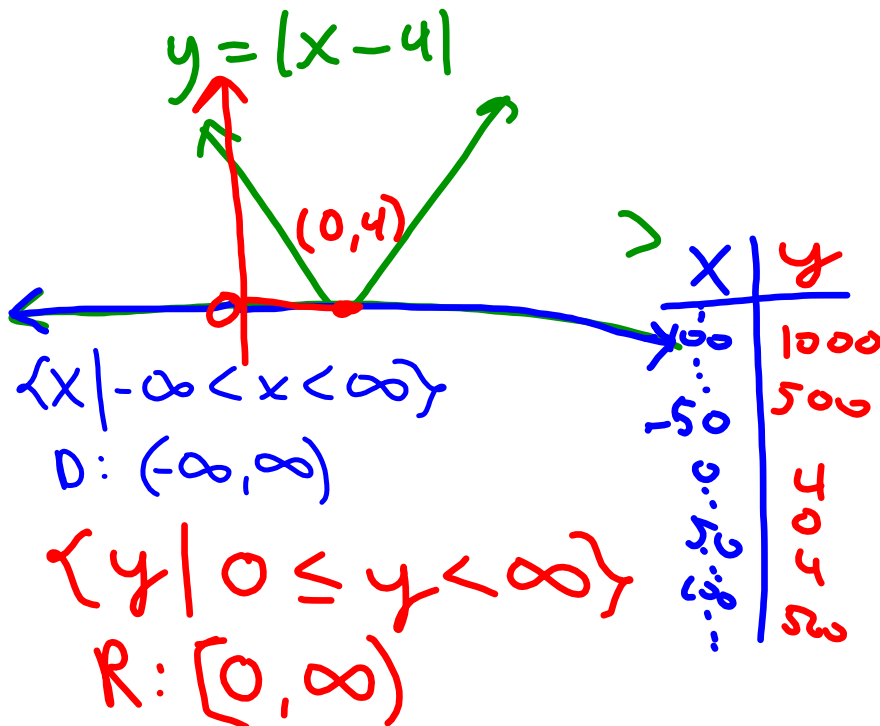
$$x \in (-\infty, \infty)$$

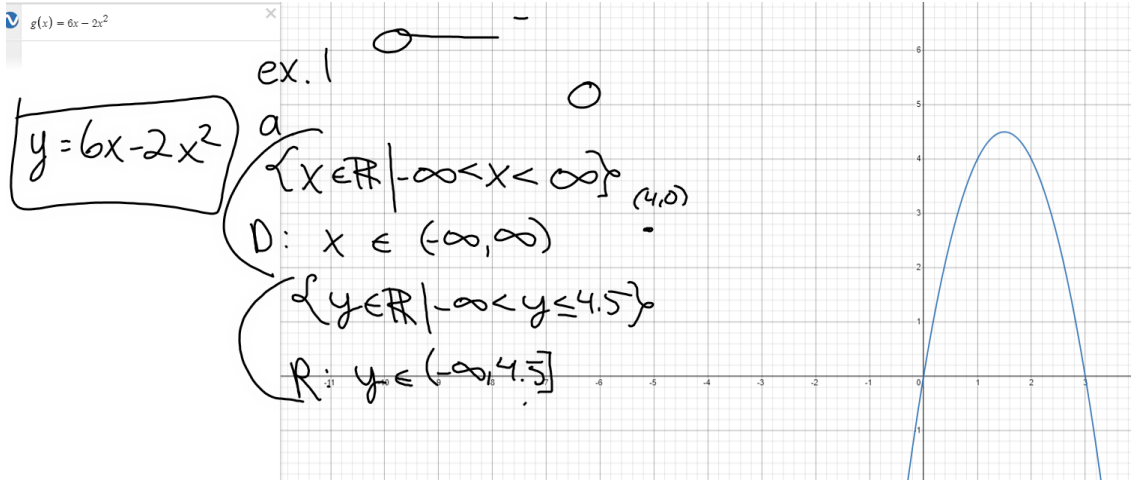
Range: what y can and can't be (Outputs)

$$y \in [-6, \infty)$$



Domain and Range Examples





$y = \sqrt{x}$

can't plug in negative #s

$D: [0, \infty)$

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

$x \neq 0$

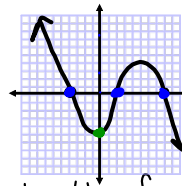
$D: (-\infty, 0) \cup (0, \infty)$
or $\mathbb{R} \setminus \{0\}$

X and Y Intercepts

x intercept (x,0) where function crosses x-axis

- (-4, 0)
- (2, 0)
- (8, 0)

sub in y=0 into the function and solve for x



y intercept (0,y) where function crosses y-axis

(0, -5)

sub in x=0 into the function and solve for y

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

① Sub 0 in for y
 $0 = 4 - x^2$
 $+x^2 \quad +x^2$
 $\sqrt{x^2} = \sqrt{4}$
 $x = \pm 2$
 $x = 2$ or $x = -2$
 ③ Put x in points

y-int: (0, 4)
 ① Sub in 0 for x
 $y = 4 - 0^2$
 $y = 4 - 0$
 $y = 4$
 ② Solve for y
 ③ Put y in point

Algebraically finding X and Y Intercepts Examples

$$y = |x| - 3$$

X int $(x, 0)$ where function crosses x-axis
 Sub in $y=0$
 $0 = |x| - 3$
 $+3 \quad +3$
 $3 = |x|$
 make 2 equations
 $x=3 \quad x=-3$
 X int $(3, 0) \cup (-3, 0)$

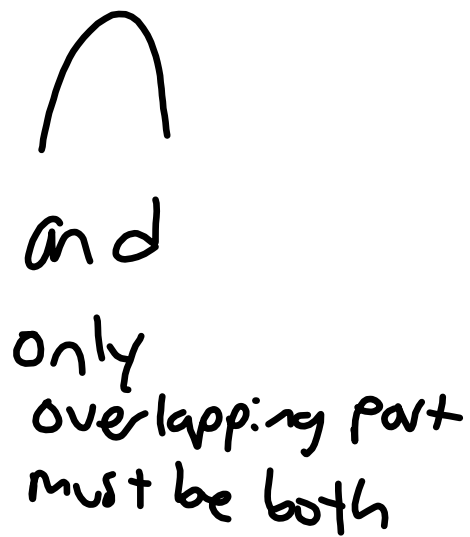
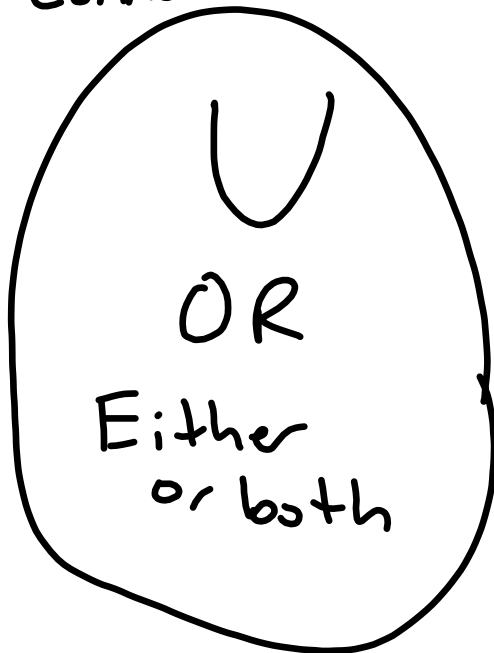
Y int $(0, y)$ where function crosses y-axis
 Sub in $x=0$
 $y = |0| - 3$
 $y = 0 - 3$
 $y = -3$
 Y int $(0, -3)$

additional example of Absolute Value Equation $2 = |x - 4|$
 $x - 4 = 2 \quad x - 4 = -2$
 $+4 \quad +4 \quad +4 \quad +4$
 $x = 6 \quad x = 2$
 $y = 4 - x^2$

X int: $y=0$
 $0 = 4 - x^2$
 $+x^2 \quad +x^2$
 $x^2 = 4 = 0$
 $(x+2)(x-2) = 0$
 $x+2=0 \quad x-2=0$
 $x=-2 \quad x=2$
 $x = \pm 2$
 $(2, 0) \cup (-2, 0)$
 X int

Y int: $x=0$
 $y = 4 - 0^2$
 $y = 4$
 Y int $(0, 4)$

Connects Intervals



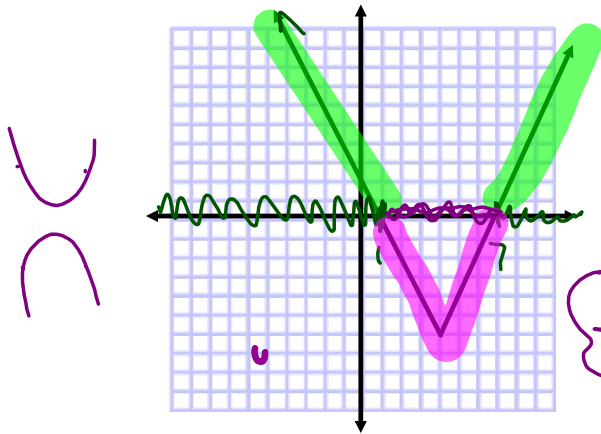
Positive and Negative Intervals

Positive Interval

(when y is positive)
(above x axis)

Negative Interval

(when y is negative)
(below x axis)
x values



Pos: $x \in (-\infty, 1) \cup (7, \infty)$

Neg: $x \in (1, 7)$

★ Find x intercepts

Increasing and Decreasing Intervals

Increasing Interval

(when the y values are getting bigger from left to right)

Decreasing Interval

(when the y values are getting smaller left to right)

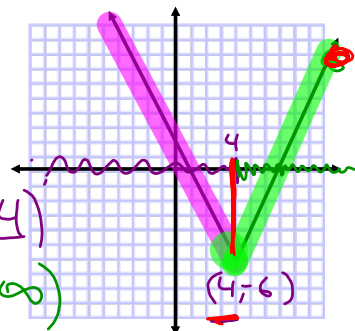
x values



look for
extrema
(maximums
+ minimums)

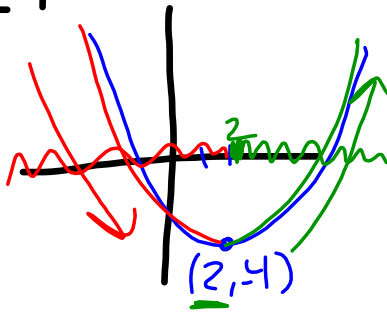
Dec: $x \in (-\infty, 4)$

Inc: $x \in (4, \infty)$



ex 4

a.



Dec: $x \in (-\infty, 2)$
 Inc: $x \in (2, \infty)$

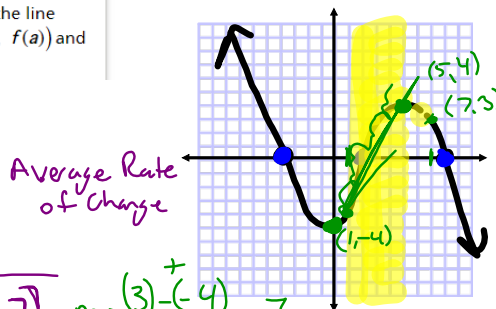
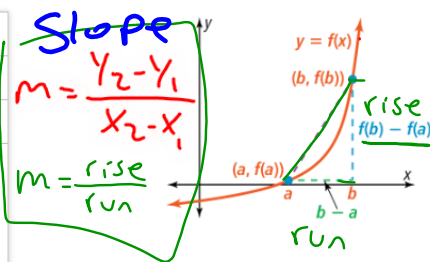
Average Rate of Change within an Intervals

A. What is the average rate of change of a function $y = f(x)$ over the interval $[a, b]$?

Interval Start and End
 Total Change y
 Interval Length x
 Average Rate of Change

The average rate of change is the ratio $\frac{f(b) - f(a)}{b - a}$.

This is the same as the slope of the line segment between the points $(a, f(a))$ and $(b, f(b))$.



When $x \in [1, 7]$, $m = \frac{3 - (-4)}{7 - 1} = \frac{7}{6}$

When $x \in [1, 5]$, $m = \frac{4 - (-4)}{5 - 1} = \frac{8}{4} = 2$

Evaluating Functions

$$f(x) = 2x - 7$$

$$f(3) = ?$$

Option 1
Plug 3
in for x
into the rule

"When $x=3$, what is the y value?"

$$f(3) = 2(3) - 7 \rightarrow (3, f(3))$$

$$= 6 - 7 = -1 \rightarrow (3, -1)$$

(x, y)

$(x, 2x-7)$

$$g(x) = |x - 4|$$

$$g(-5) = |-5 - 4|$$

$$= |-9|$$

$$g(-5) = 9$$

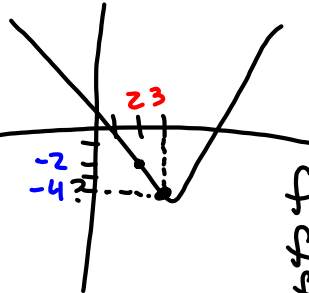
$(x, g(x))$

$(-5, g(-5))$

$(-5, 9)$

Option 2

Find the y value of the point on the function at that x value



$$f(3) = -4$$

$$f(2) = -2$$

$$f(0) =$$

Lesson 1-1 Key Features of Functions Worksheet

Name:

Date:

Classify each of the polynomials by degree and number of terms.

- $8x^4 + 5x^2 - 4x - 2$
- $-9x^2 + 5$
- Create a Cubic Trinomial

- State the domain and range, and if it is a function.
 - $\{(-5,4), (-4,-1), (-2,1), (0,4), (1,3)\}$

Domain:

Range:

Function? Yes or No

- $\{(-3,-4), (-1,2), (0,0), (-3,5), (2,4)\}$

Domain:

Range:

Function? Yes or No

- Use a graphing calculator tool to sketch and determine which of the following are functions.

	Sketch	Yes/No
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a. $y = 3(x - 4)^2 - 5$

b. $y = x - 6$

c. $9 = x^2 + y^2$

(Review Practice) Add and subtract the following polynomials by combining like terms.

- $(5x^3 - 2x) + (5 - 2x) + (-4x^2 - 7)$
- $(9y^2 - 5y^3 + 4) - (2y^2 - 19y + 8)$

Determine the domain and range of the following graph. Write your answer in Set Builder Notation ex. $\{x \in \mathbf{R} | -3 < x \leq 9\}$

<p>8.</p> <p>Domain: $\{x \in \mathbf{R} -\infty < x < \infty\}$</p> <p>Range: $\{y \in \mathbf{R} -3 \leq y < \infty\}$</p> <p>Function? Yes or No</p>	<p>9.</p> <p>Domain: $\{x \in \mathbf{R} -2 < x \leq 2\}$</p> <p>Range: $\{y \in \mathbf{R} -2 < y < 2\}$</p> <p>Function? Yes or No</p>	<p>10.</p> <p>Domain:</p> <p>Range:</p> <p>Function? Yes or No</p>
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Lesson 1-1 Key Features of Functions Worksheet

Name: Key Date:

Classify each of the polynomials by degree and number of terms.

1. $8x^3 + 5x^2 - 4x - 2$
 Cubic, 4 term Polynomial

2. $-9x^2 + 5$
 Quadratic Binomial

3. Create a Cubic Trinomial

$ax^3 + bx + c$
 $3x^3 - 3x - 2$
 $x^3 + x^2 + 5x$ (x, y)

4. State the domain and range, and if it is a function

a. $(-5, 4), (-4, 3), (-2, 1), (0, 4), (1, 3)$

Domain: $x \in \{-5, -4, -2, 0, 1\}$

Range: $y \in \{-1, 1, 3, 4\}$ (no points)

Function? (Yes or No) Every x value is different and has a y value

b. $(-3, 4), (-1, 2), (0, 0), (3, 5), (2, 4)$

Domain: $x \in \{-3, -1, 0, 2, 3\}$ (x=3 repeated)

Range: $y \in \{-4, 0, 2, 4, 5\}$

Function? (Yes or No) When -3 went in for x two different y values came out 4 and 5
 (Review Practice) Add and subtract the following polynomials by combining like terms.

5. $(5x^3 - 2x) + (5 - 2x) + (-4x^3 - 7)$

$5x^3 - 4x^3 - 2x - 2x + 5 - 7$

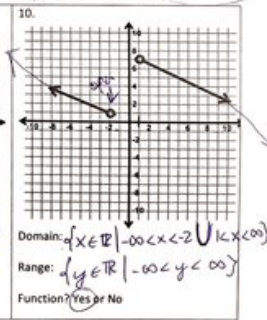
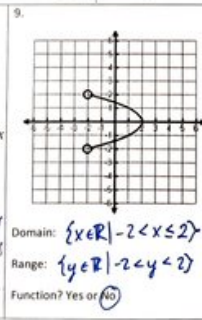
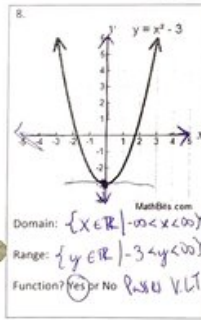
$x^3 - 4x - 2$

7. $(9y^2 - 5y^3 + 4) + (2y^3 - 6y^2 + 8)$

$-5y^3 - 2y^3 + 9y^2 + 14y^2 + 4 - 8$

$-7y^3 + 9y^2 + 14y - 4$

Determine the domain and range of the following graphs. Write your answer in Set Builder Notation ex. $\{x \in \mathbb{R} | -3 < x \leq 9\}$



Determine the domain and range of the following graphs. Write your answer in Interval Notation ex. $x \in (-3, 9]$

