Math 4

1-1 Function Families Review

Name _____

Date _____

In this investigation, you will be working towards the following learning objectives:
- *I can review and extend properties of basic function families and their uses in mathematical modeling*
- *I can solve problems involving basic function families*

Use the following function to answer the questions below: $f(x) = \dfrac{x-1}{x+1}$

1. Complete the following table of values.

x	-10,000	-1000	-100	-10	0	10	100	1000	10,000
f(x)	$1.\overline{0002}$	$1.\overline{002}$	$1.\overline{02}$	$1.\overline{2}$	-1	$0.\overline{81}$	$0.\overline{9801}$	0.998	0.9998

2. As the value of x decreases, what value does f(x) appear to approach? ____1____

3. As the value of x increases, what value does f(x) appear to approach? ____1____

4. What is the domain? (use *interval notation*)

$$(-\infty, -1) \cup (-1, \infty)$$
$$\{x : x = -1\}$$

5. What is the range? (use *interval notation*)

$$(-\infty, 1) \cup (1, \infty)$$
$$\{y : y \neq 1\}$$

Important Vocabulary:

A function is **even** if _it is symmetric about the y-axis_ .

A function is **odd** if _it has 180° rotational symmetry about the origin_ .

6. Draw an example of an even function.
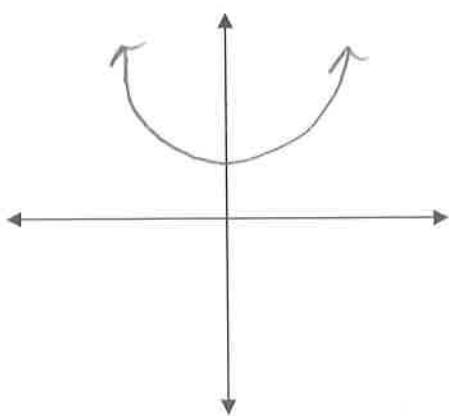
7. Draw an example of an odd function.
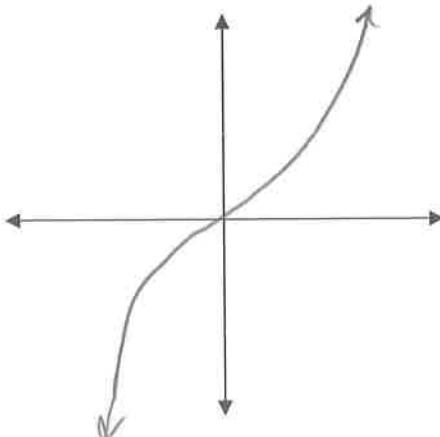
List the type, characteristics and sketch a graph for the following functions.

Linear Functions

8. General Rule:

$$f(x) = a + bx$$

Specific Function:

$$f(x) = \frac{3}{2}x - 5$$

Domain:

$X \in \mathbb{R}$

Range:

$Y \in \mathbb{R}$

Symmetries (if any):

Even, Odd, Neither, ⟨Both⟩ → Only $f(x) = 0$
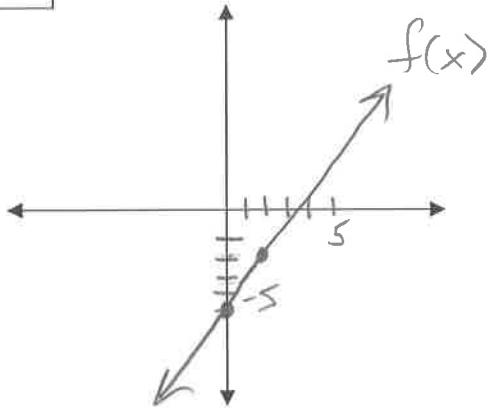
Asymptotes (if any):

None

What happens if the lead coefficient has the opposite sign?

Negative slope. Graph decreases. As x increases, y decreases.

Quadratic Functions

9. General Rule:

$$f(x) = ax^2 + bx + c$$

Specific Function:

$$f(x) = -4x^2 + 7x - 19$$

Domain:

$X \in \mathbb{R}$

Range:

$\{ Y : y \geq C \}$

Symmetries (if any):

⟨Even⟩, Odd, ⟨Neither⟩

Asymptotes (if any):

None
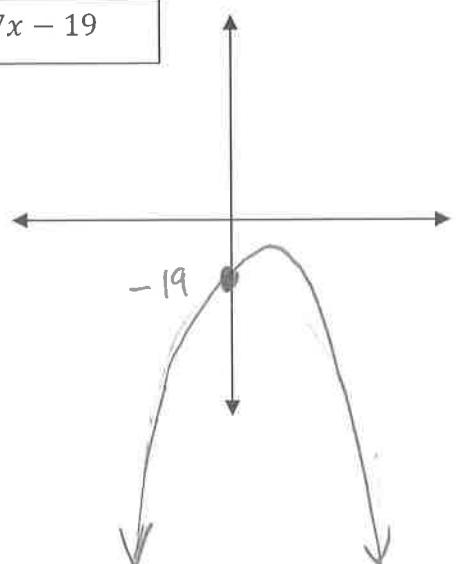
What happens if the lead coefficient has the opposite sign?

The parabola opens upward

Exponential Functions

10. General Rule:

$$f(x) = a \cdot b^x$$

Specific Function:

$$f(x) = e^x$$

Domain:

$X \in \mathbb{R}$

Range:

$\{ Y : Y > 0 \}$ or $\{ y : y < 0 \}$ if $a < 0$

Symmetries (if any):

Even, Odd, (Neither)

Asymptotes (if any):

$Y = 0$ (horizontal)

The function above is an example of exponential growth. Give an example of a function that represents exponential decay:

$$g(x) = 7 \left(\tfrac{1}{2} \right)^x$$

Logarithmic Functions

11. General Rule:

$$f(x) = \log_b x$$

Specific Function:

$$f(x) = \ln(x)$$

Domain:

$\{ x : x > 0 \}$

Range:

$Y \in \mathbb{R}$

Symmetries (if any):

Even, Odd, (Neither)

Asymptotes (if any):

$X = 0$ (vertical)

How does the function above relate to $g(x) = e^x$?

They are inverses!
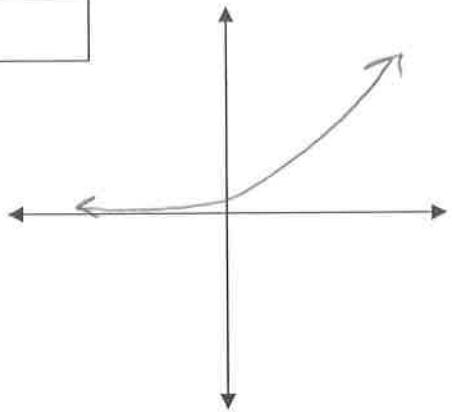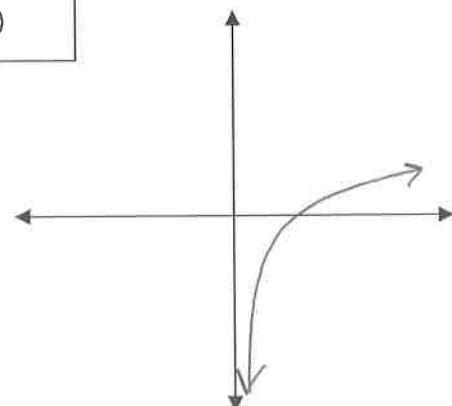
Power (Direct variation) Functions

12. General Rule:

$$f(x) = kx^r$$

Specific Function:

$$f(x) = x^3 - \frac{5}{2}x^2 - 2x$$ ~~(crossed out)~~ $4x^3$

Domain:

$X \in \mathbb{R}$

Range:

Depends on r $Y \in \mathbb{R}$ if r is odd

$Y \geq 0$ if r is even

Symmetries (if any):

(Even, Odd,) Neither

if r is even   if r is odd

Asymptotes (if any):

None
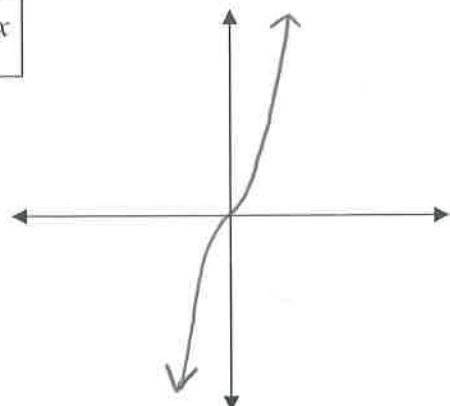
How is the graph affected by the lead coefficient?

$\cup$ vs $\cap$ $+$ $-$

Inverse Variation Functions

13. General Rule:

$$f(x) = \frac{k}{x^r}$$

Parent Function:

$$f(x) = \frac{6}{x^2}$$

Domain:

$\{x : x \neq 0\}$

Range:

If $r =$ even $y > 0$ or $y < 0$ & if $r =$ odd

$\{y : y \neq 0\}$

Symmetries (if any):

(Even,) Odd, Neither

Asymptotes (if any):

$Y = 0$ (horizontal) & $x = 0$ (vertical)
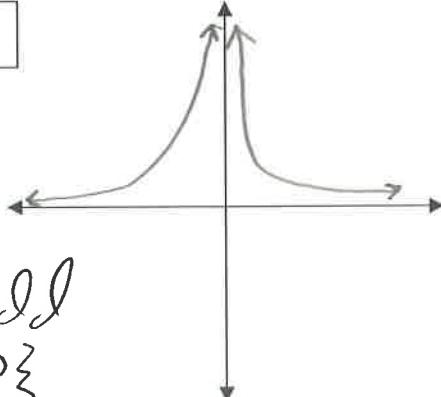
How would your graph change if x was raised to an odd power?

Graph would be in quadrants 1 & 3

How would your graph change if the constant term was negative?
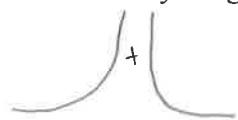
or

Sine and Cosine Functions

14. General Rule:

$$f(x) = a \sin bx + c$$

Specific Function:

$$f(x) = 5 \sin(x)$$

Domain:

$$X \in \mathbb{R}$$

Range:

$$\{ y : c - |a| \leq y \leq c + |a| \}$$

Symmetries (if any):

Even, ~~Odd~~, Neither   → if shifted

Asymptotes (if any):
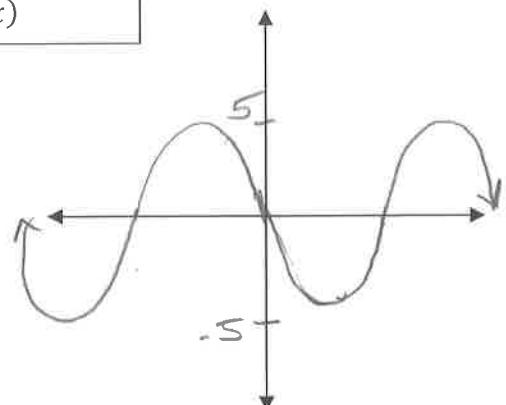
None

15. General Rule:

$$f(x) = a \cos bx + c$$

Specific Function:

$$f(x) = -3 \cos(x) + 4$$

$$-3 + 4 = 1$$

Domain:

$$X \in \mathbb{R}$$

Range:

$$\{ y : \{ c - |a| \leq y \leq c + |a| \}$$

Symmetries (if any):   → If shifted

~~Even~~, Odd, Neither

Asymptotes (if any):

None
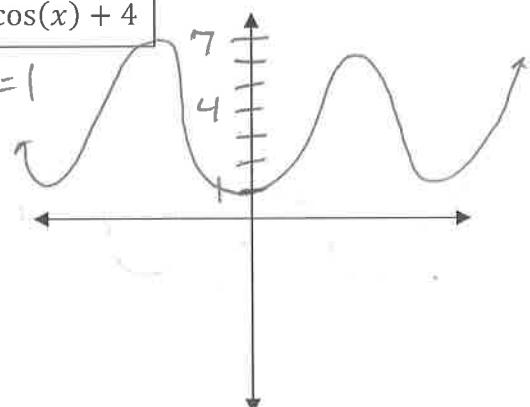
How does the *a* value affect the functions above?

- Changes the amplitude
- Vertical stretch or compression

How does the *b* value affect the functions?

- Changes the period of the graph

How does the *c* value affect the functions?

- Vertical shift
- y-displacement