QUIZ DATE: ___________ **TEST DATE: ____________________**

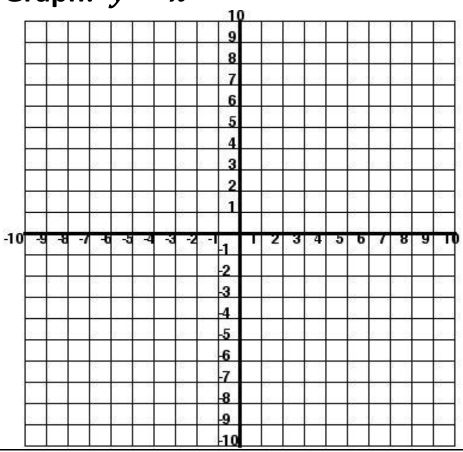
Math 2 **Name_____________________________**

Unit 4 – Radical & Rational Functions **Date________________________Pd______**

Lesson 1 → Square Root & Cube Root Graphs

- Graphs of **Parent Functions:**

Graph: $y = x^2$

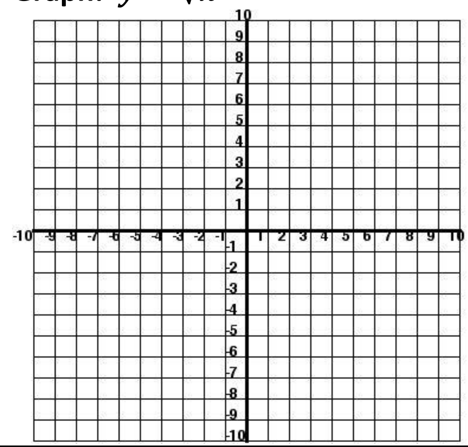


Vertex:

Domain:

Range:

Graph: $y = \sqrt{x}$

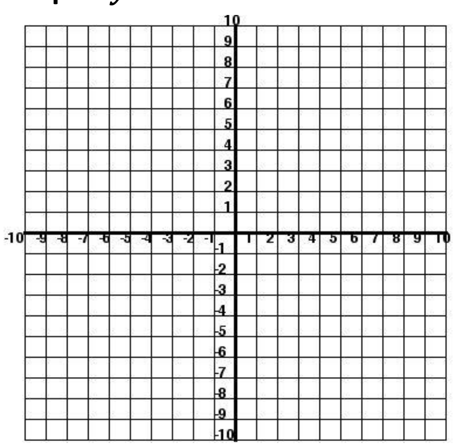


Vertex:

Domain:

Range:

Graph: $y = x^3$

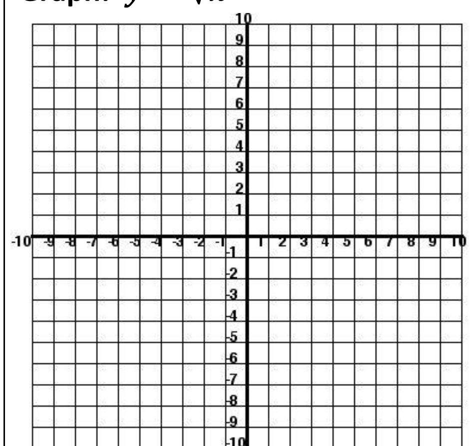


Vertex:

Domain:

Range:

Graph: $y = \sqrt[3]{x}$

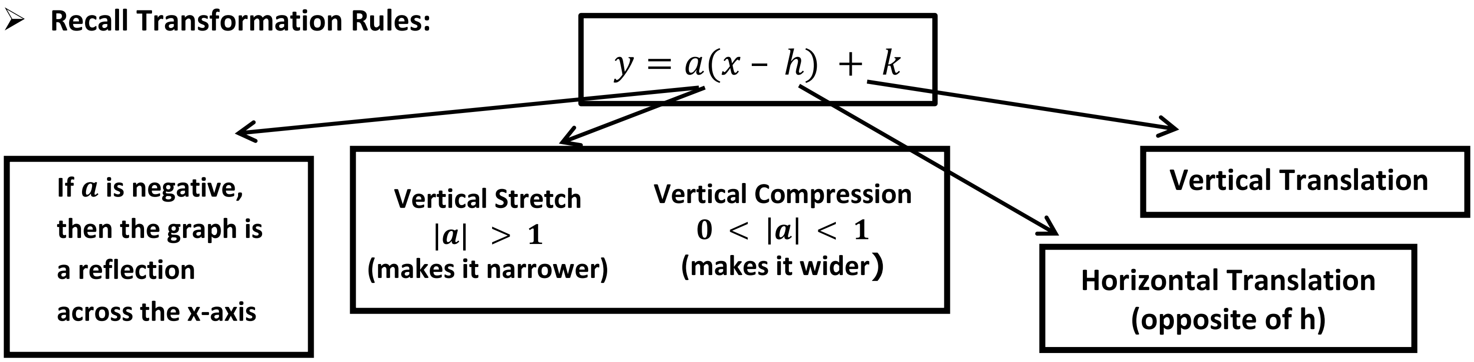


Vertex:

Domain:

Range:

- **Recall Transformation Rules:**



Quadratic Function	Vertex	Shift Left or Right	Shift Up or Down
$y=(x-3)^2+6$			
$y=(x+1)^2$			
$y=x^2-4$			

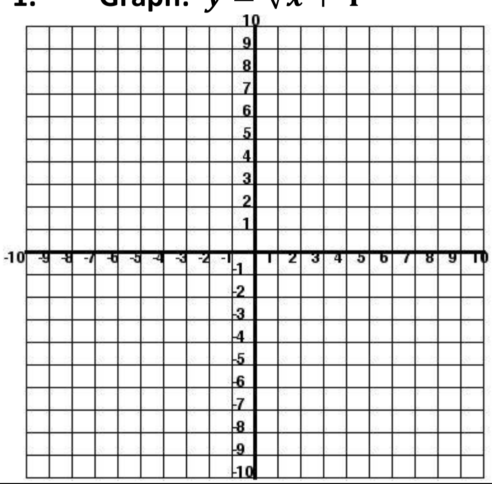
Cubic Function	Vertex	Shift Left or Right	Shift Up or Down
$y=(x+2)^3-5$			
$y=x^3+7$			
$y=(x-8)^3$			

Square Root Function	Vertex	Shift Left or Right	Shift Up or Down
$y=\sqrt{x-2}+5$			
$y=\sqrt{x}-1$			
$y=\sqrt{x+3}$			

Cube Root Function	Vertex	Shift Left or Right	Shift Up or Down
$y=\sqrt[3]{x}-9$			
$y=\sqrt[3]{x+2}+4$			
$y=\sqrt[3]{x-8}$			

- Graph using Transformation Rules:

1. **Graph:** $y=\sqrt{x+4}$

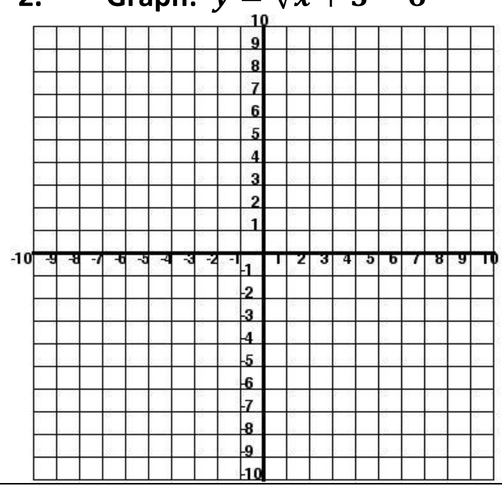


Vertex:

Domain:

Range:

2. **Graph:** $y=\sqrt{x+3}-6$

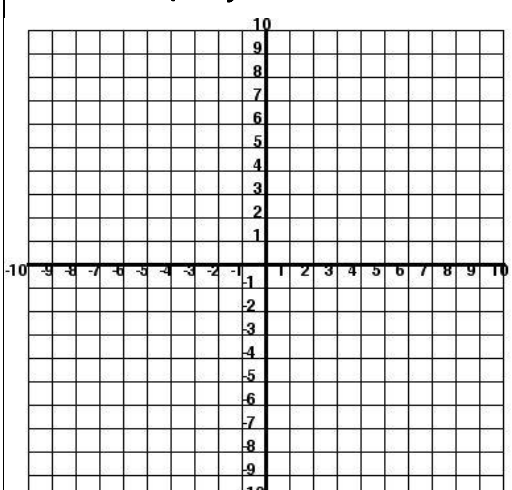


Vertex:

Domain:

Range:

3. **Graph:** $y=\sqrt[3]{x}+2$

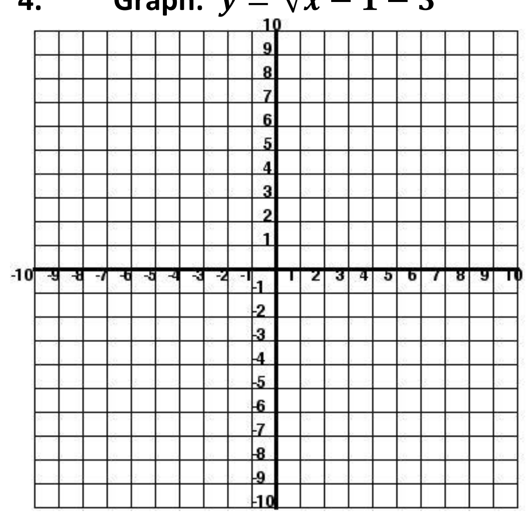


Vertex:

Domain:

Range:

4. **Graph:** $y=\sqrt[3]{x-1}-3$

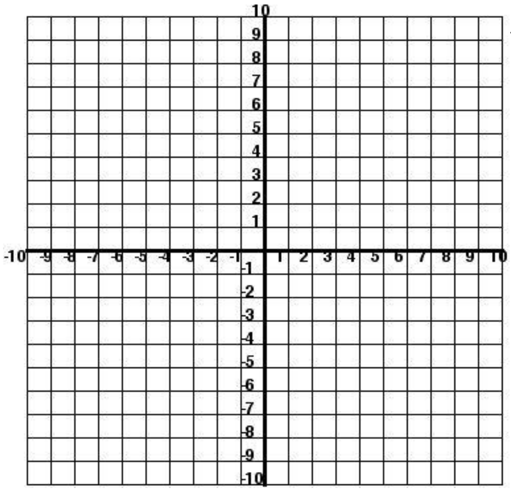


Vertex:

Domain:

Range:

5. **Graph:** $y = -\sqrt{x} + 2$

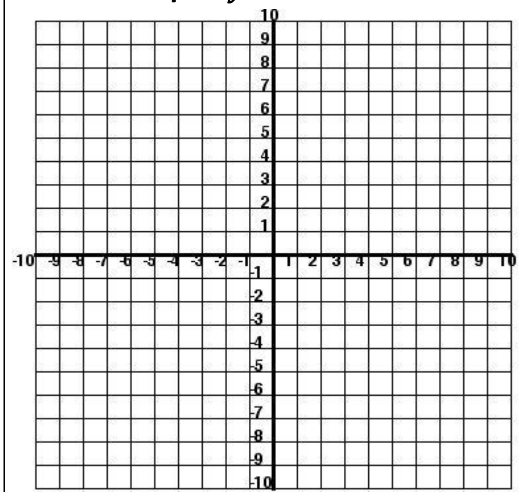


Vertex:

Domain:

Range:

6. **Graph:** $y = -\sqrt[3]{x + 1}$



Vertex:

Domain:

Range:

7. Write the equation of a **square root** function with a vertex at $(-5, 3)$.

8. Write the equation of a **square root** function that has been translated right ten units and up six units.

9. Write the equation of a **cube root** function that has been translated left three units and down two units.

10. Write the equation of a **square root** function that has been translated right four units and reflected across the $x - axis$.

Math 2
Unit 4 – Radical & Rational Functions
Lesson 1 → Square Root & Cube Root Graphs HOMEWORK

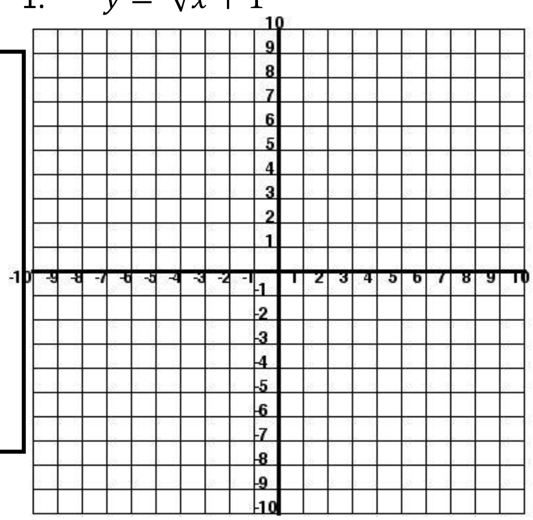
Name________________________________
Date__________________________**Pd**______

➢ Complete the table:

Function	**Vertex**	**Horizontal Translation** Left or Right	**Vertical Translation** Up or Down	**Vertical Stretch or Compression**	**Reflection over x-axis**	**Domain**	**Range**
$y = -\sqrt{x+4} - 1$							
$y = \sqrt{x-3} + 2$							
$y = -3\sqrt{x+1} + 2$							
$y = \sqrt[3]{x} + 4$							
$y = \sqrt[3]{x+4} - 5$							
$y = -4\sqrt[3]{x+3}$							
$y = \frac{1}{2}\sqrt{x+3} - 4$							

➢ Sketch each graph:

1. $y = \sqrt{x} + 1$

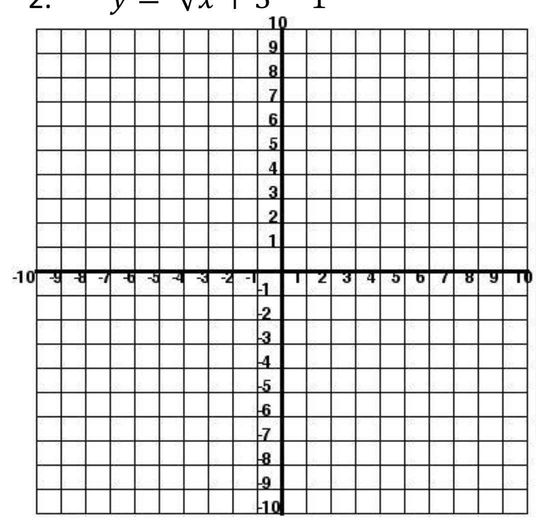


Vertex:

Domain:

Range:

2. $y = \sqrt{x+3} - 1$

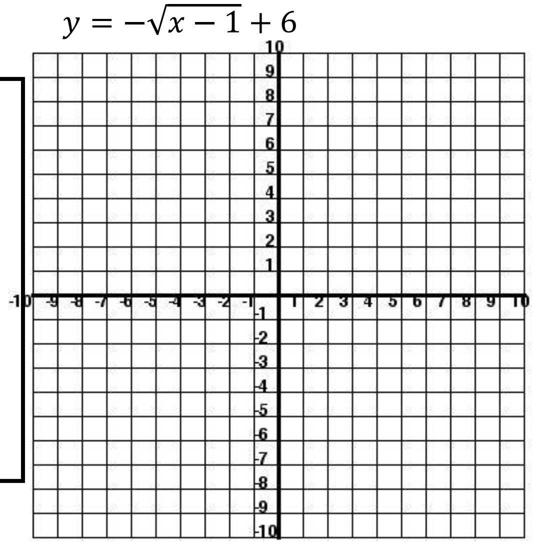


Vertex:

Domain:

Range:

3. $y = -\sqrt{x-1} + 6$

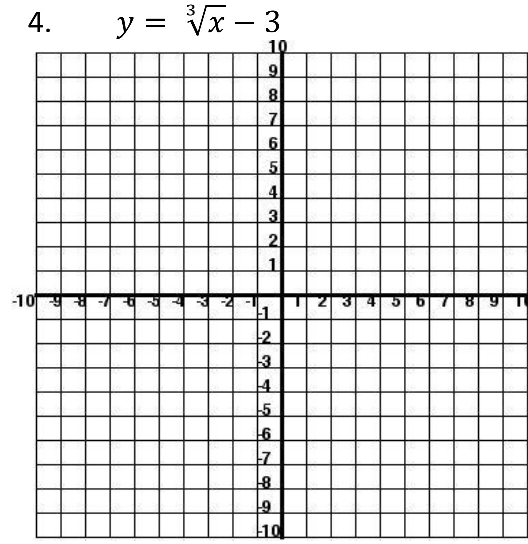


Vertex:

Domain:

Range:

4. $y = \sqrt[3]{x} - 3$



Vertex:

Domain:

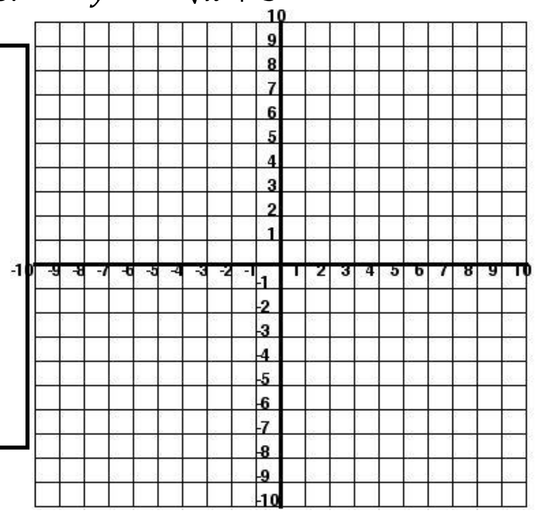
Range:

5. $y = -\sqrt[3]{x+3}$

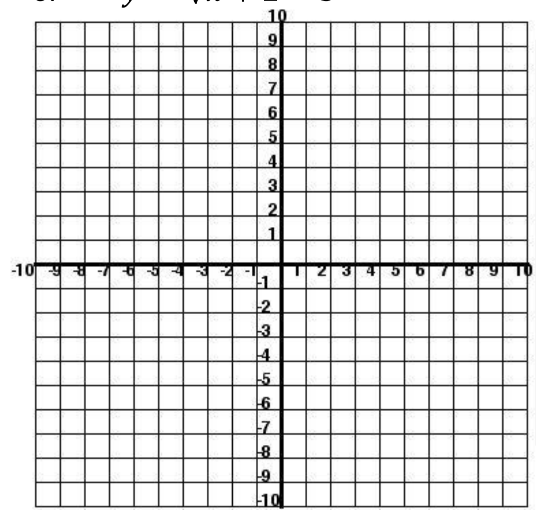
Vertex:

Domain:

Range:



6. $y = \sqrt[3]{x+2} - 5$



Vertex:

Domain:

Range:

- Write the equation of the function:

7. Write the equation of a **cubed** function that has been translated left four units and up six units.

8. Write the equation of a **cube root** function that has been translated left seven units and down one unit.

9. Write the equation of a **cube root** function that has been translated left four units and up six units and reflected across the $x - axis$.

10. Write the equation of a **square root** function that has been translated right three units and down two units.

11. Write the equation of a **square root** function that has been translated left two units and reflected across the $x - axis$.

12. Write the equation of a **square root** function that has been translated up two units and reflected across the $x - axis$ and stretched by a factor of 2.

Math 2 Name_________________________________
Unit 4 – Radical & Rational Functions Date__________________________Pd______
Lesson 2 → Square Root & Cube Root Equations

There are three steps to solving a radical equation:
1) Isolate the radical.
2) Raise both sides to the power of the root.
3) Solve for x.

➢ Examples:

1. $\sqrt{x} = 8$ $x =$ __________________	2. $\sqrt{x+7} = 8$ $x =$ __________________	3. $2\sqrt{x+6} = 14$ $x =$ __________________
4. $-4\sqrt{x} + 11 = 3$ $x =$ __________________	5. $\sqrt{x-2} - 2 = 2$ $x =$ __________________	6. $-3\sqrt[3]{2x+5} = -21$ $x =$ __________________
7. $\sqrt{10x^2 - 49} = 3x$ $x =$ __________________	8. $\sqrt{2x-6} = \sqrt{5x-15}$ $x =$ __________________	9. $\sqrt[3]{6x-5} = \sqrt[3]{3x+2}$ $x =$ __________________

Math 2 **Name________________________________**

Unit 4 – Radical & Rational Functions **Date_________________________Pd______**

Lesson 2 → Square Root & Cube Root Equations HOMEWORK

1. $\sqrt{x-1} = 3$ $x =$ ___________________	2. $2 = \sqrt{\frac{x}{2}}$ $x =$ ___________________
3. $\sqrt{-8+2x} = 0$ $x =$ ___________________	4. $\sqrt{x+4} = 7$ $x =$ ___________________
5. $\sqrt[3]{x-3} = 5$ $x =$ ___________________	6. $\sqrt{2x-6} = \sqrt{3x-14}$ $x =$ ___________________
7. $\sqrt{8x} = x$ $x =$ ___________________	8. $\sqrt[3]{9-x} = \sqrt[3]{1-9x}$ $x =$ ___________________
9. $\sqrt{3-2x} = \sqrt{1-3x}$ $x =$ ___________________	10. $x = \sqrt{20-x}$ $x =$ ___________________

Math 2 **Name________________________________**
Unit 4 –Radical & Rational Functions **Date_________________________Pd______**
Lesson 3 → Graphs of Rational Functions

- A rational function is a function that can be written as the ratio of two polynomials where the denominator does not equal zero.

- $f(x) = \frac{p(x)}{q(x)}$ where $q(x) \neq 0$

❖ **Steps to graph a rational function:** $\boldsymbol{y = \frac{n}{x-h} + k}$

1) Determine the location of the asymptotes based on the transformations:

   A) Vertical asymptotes are placed based on the **horizontal translation**: $\boldsymbol{x = h}$

   B) Horizontal asymptotes are placed based on the **vertical translation**: $\boldsymbol{y = k}$

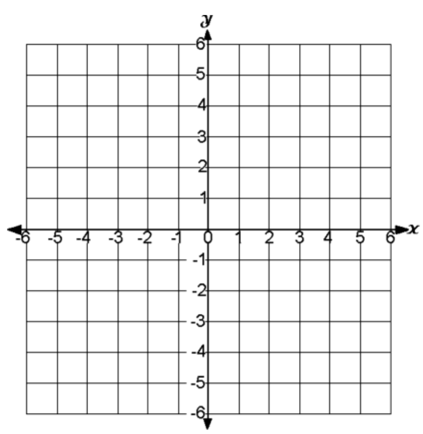
2) **Vertical Stretch or Compression**: $\boldsymbol{n}$ tells us how far the branches have been stretched from the asymptotes. We can use it to help us find out corner points to start our branches.

   Distance from asymptotes = $\boldsymbol{\sqrt{n}}$

3) Look at the table on the calculator for other points and then sketch the two branches.

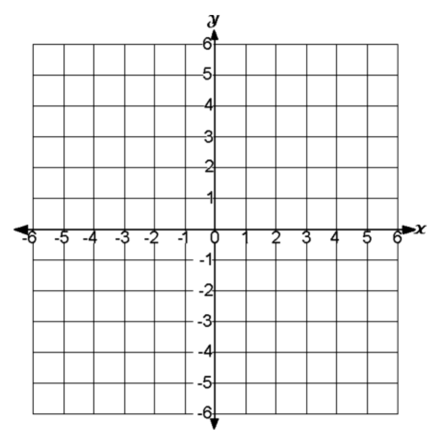
❖ Graph each of the following examples:

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



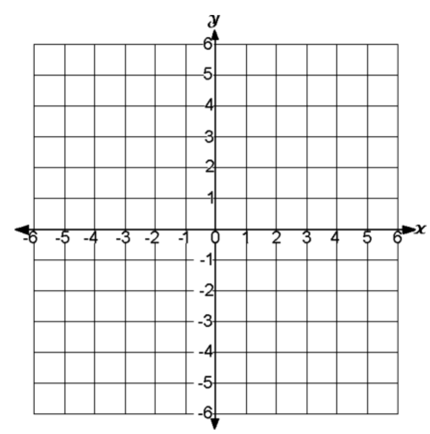
Equation of VA:
Equation of HA:
Describe translations:
Domain:
Range:

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



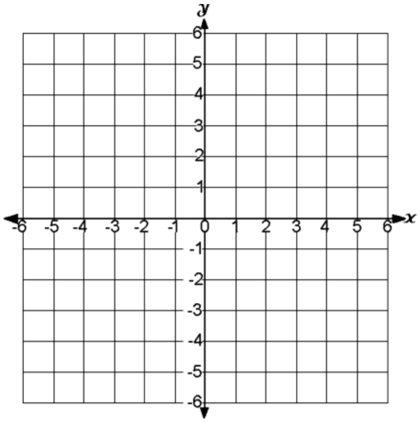
Equation of VA:
Equation of HA:
Describe translations:
Domain:
Range:

3. $y = -\frac{4}{x+1}$



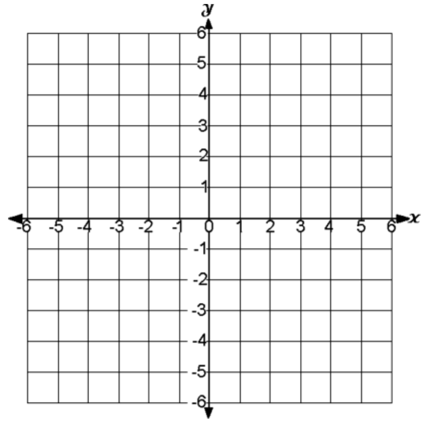
Equation of VA:
Equation of HA:
Describe translations:
Domain:
Range:

4. $y = \frac{1}{x} - 4$



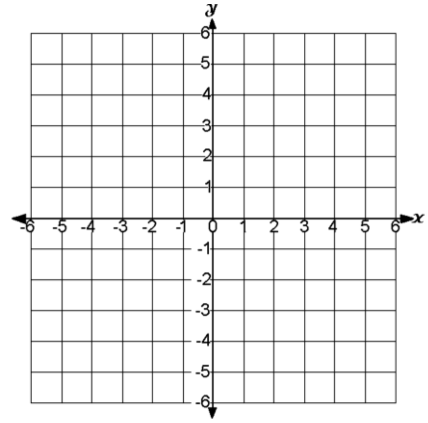
Equation of VA:
Equation of HA:
Describe translations:
Domain:
Range:

5. $xy = 9$



Equation of VA:
Equation of HA:
Describe translations:
Domain:
Range:

6. $y = \frac{3}{x-2} - 3$



Equation of VA:
Equation of HA:
Describe translations:
Domain:
Range:

7. Describe each graph as compared to the parent graph $y = \frac{1}{x}$.

$y = \frac{-2}{x-7} + 5$	$y = \frac{7}{x+2} - 4$
The graph of this ______________________function has been translated _________ seven units and translated _____ units _________. It has been vertically stretched by a factor of ______ and ________________ across the x-axis. The graph is increasing from __________ to ___________. The function has a domain of _______________ and a range of ________________.	The graph of this ______________________function has been translated _________ two units and translated ____ units __________. It has been vertically stretched by a factor of _______. The graph is __________________ from left to right. The function has a domain of _______________ and a range of ________________.

8. Write the equation of a rational function $y = \frac{1}{x}$ with following transformations:

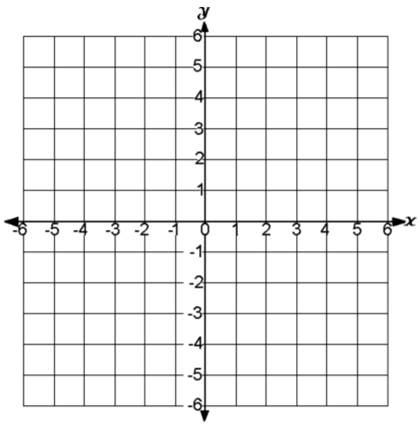
A. Right 4 and Down 5	B. Left 3 and Up 2 and Reflected across $x - axis$.
C. Left 6 and Vertically Stretched by a factor of 4.	D. Right 5 and graph will be in II & IV quadrants

Math 2 Name________________________________

Unit 4 – Radical & Rational Functions Date__________________________Pd______

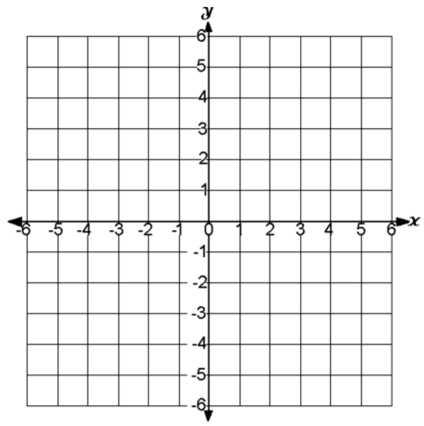
Lesson 3 → Graphing Rational Functions HOMEWORK

1. $y = \frac{1}{x} + 3$



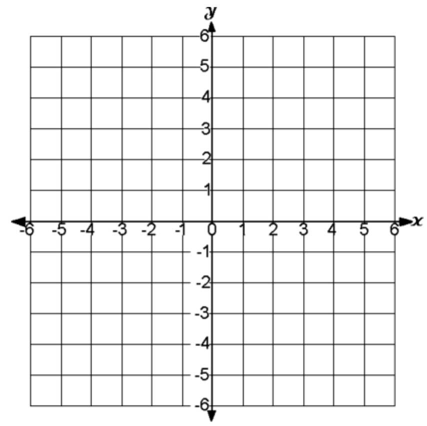
D: ____________ **R**: ____________

2. $y = \frac{1}{x-3}$



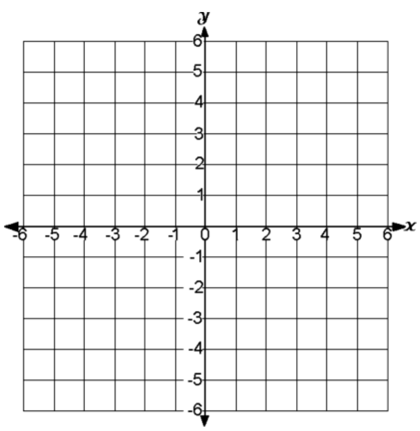
D: ____________ **R**: ____________

3. $y = \frac{1}{x+2} - 1$



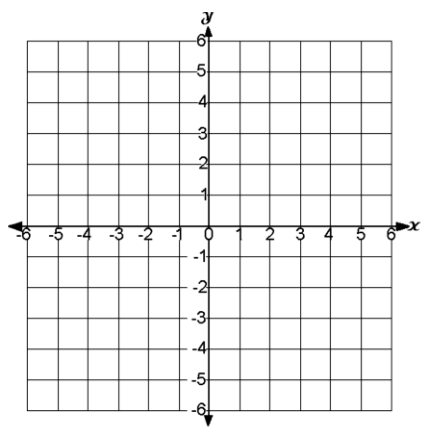
D: ____________ **R**: ____________

4. $y = \frac{2}{x}$



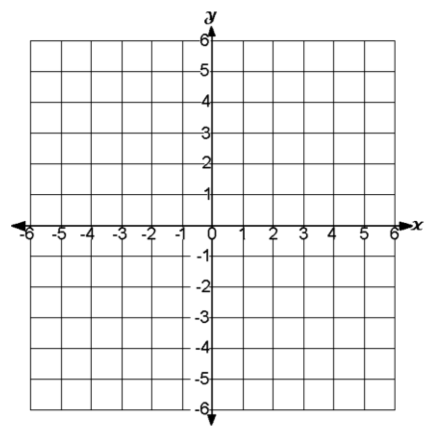
D: ____________ **R**: ____________

5. $y = \frac{3}{x+1}$



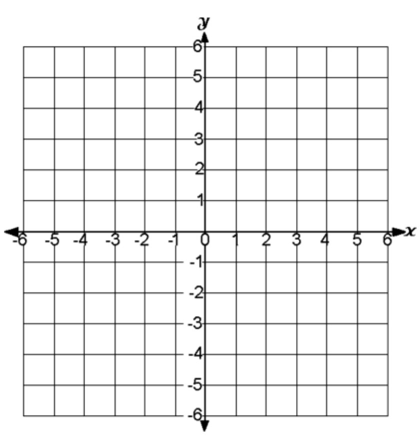
D: ____________ **R**: ____________

6. $y = \frac{4}{x-4} + 2$



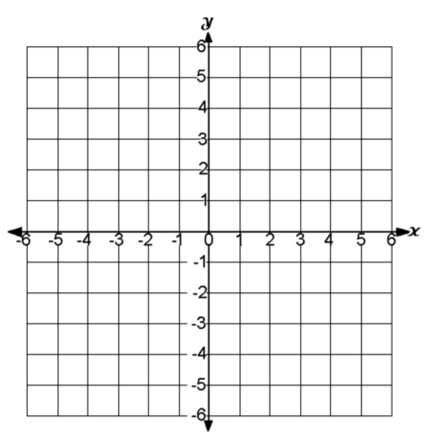
D: ____________ **R**: ____________

7. $y = -\frac{1}{x}$



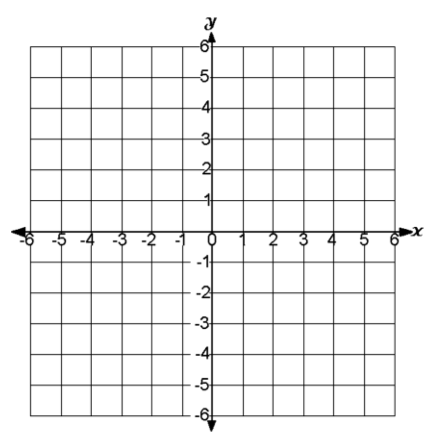
D: ____________ **R**: ____________

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



D: ____________ **R**: ____________

9. $y = -\frac{2}{x+1} - 2$



D: ____________ **R**: ____________

10. Consider the equation: $y = \frac{9}{x+1} - 2$

A) For what value is the function undefined (makes denominator = 0)? _______________________

B) What is the equation of the vertical asymptote? ________________________________

C) What is the equation of the horizontal asymptote? _____________________________

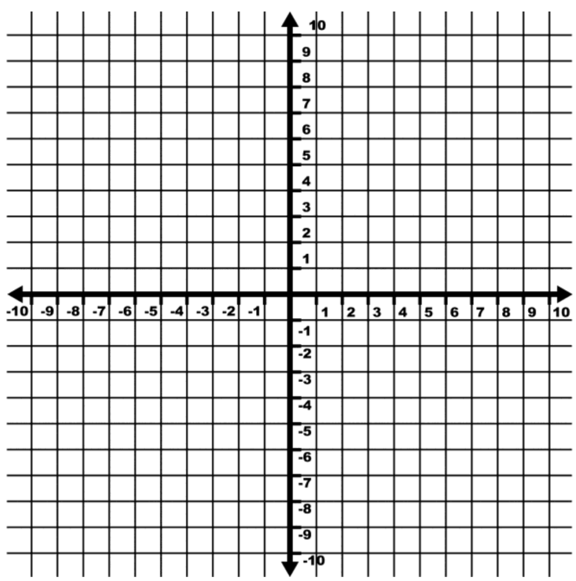
D) What is the domain of the function? __________________________

E) What is the range of the function? ___________________________

F) What is the distance of the turning point from the intersection of the asymptotes? ___________

G) In which quadrant is the center point located? _____________________________

H) Graph the equation:



Math 2
Unit 4 – Radical & Rational Functions
Lesson 4 → Rational Equations

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- **Recall**: A rational function is a function that can be written as the ratio of two polynomials where the denominator does not equal zero: $\boldsymbol{f(x) = \frac{p(x)}{q(x)}}$ where $q(x) \neq 0$

- When solving rational equations with variables in the denominator, you must check the solution to be sure the denominator will not equal zero. **The solution will be eliminated if the denominator is zero**.

Examples: Solve for x.

1. $\frac{6}{x} = \frac{3}{7}$ $x =$ ________________	2. $\frac{4}{x-7} = \frac{6}{x}$ $x =$ ________________
3. $\frac{-5}{x+4} = \frac{1}{x+4}$ $x =$ ________________	4. $\frac{4}{x+5} = \frac{x}{6}$ $x =$ ________________
5. $\frac{x-4}{4} + \frac{x}{3} = 6$ $x =$ ________________	6. $\frac{3}{2x} - \frac{2x}{x+1} = -2$ $x =$ ________________

Math 2
Unit 4 – Radical & Rational Functions
Lesson 4 → Rational Equations HOMEWORK

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Date_________________________**Pd**______

- Solve for x:

1. $\frac{3}{x} = \frac{2}{x+4}$ $x =$ ________________	2. $\frac{x+1}{2x+5} = \frac{2}{x}$ $x =$ ________________
3. $\frac{3}{x+2} + 5 = \frac{4}{x+2}$ $x =$ ________________	4. $\frac{6}{x-3} = \frac{x}{18}$ $x =$ ________________
5. $\frac{5x}{x+2} + \frac{2}{x} = 5$ $x =$ ________________	6. $\frac{2x-3}{7} - \frac{x}{2} = \frac{x+3}{14}$ $x =$ ________________

Math 2
Unit 4 - Radical & Rational Functions
Lesson 5 → Types of Variations

Name________________________________
Date_________________________**Pd**______

- **DIRECT VARIATION:** Linear function with a y-intercept of 0. In a direct variation, both of the quantities are either increasing or both are decreasing.
- There are two methods for solving a direct variation problem:

  1) Equation of Variation: $y = kx$ where k is called the **constant of variation**
  2) Proportion: $\frac{y_1}{x_1} = \frac{y_2}{x_2}$

#1: The distance that a body near Earth's surface will fall from rest varies directly as the **square** of the number of seconds it has been falling. If a boulder falls from a cliff a distance of $122.5\ m$ in $5\ seconds$, approximately how far will it fall in $8\ seconds$?

Method 1	Method 2

- **JOINT VARIATION**: more than two quantities in a **direct variation** relationship
- Equation of Variation: $y = kxz$ where k is called the **constant of variation**

#2: If $y\ varies\ jointly\ as\ x\ and\ z$, and $y = \frac{1}{2}$ when $x = 27$ and $z = \frac{-2}{3}$, find y when $x = 9$ and $z = 18$.

- **INVERSE VARIATION:** Rational function with vertical and horizontal asymptotes. In an inverse variation, one of the quantities is increasing while the second quantity is decreasing.
- Equation of Variation: $y = \frac{k}{x}$ where k is called the **constant of variation**

#3: The time of a trip varies inversely as the speed of the car. If a car being driven at $55\ mph$ takes $2\ hours$ to get from Wake Forest to Greensboro, how fast is the car traveling if the trip takes $2.5\ hours$?

- **COMPOUND VARIATION:** Both Inverse and Direct Variation in the same problem

- Equation of Variation: $y = \frac{kx}{z}$ where k is called the **constant of variation**

#4: The volume of gas varies directly with Kelvin temperature and inversely with pressure. If a certain gas has a volume of $342\ cubic\ meters$ at a temperature of $300\ Kelvin\ degrees$ under a pressure of $200\ KPa\ (kilopascals)$, what will be the volume of the same gas at a temperature of $320\ Kelvin\ degrees$ under a pressure of $400\ kPA$?

- **State whether each equation represents a direct, inverse, joint or compound variation. Then state the constant of variation.**

1. $y = \frac{9}{x}$	2. $z = 5xy$	3. $y = \frac{8x}{z}$	4. $y = 2x$	5. $xy = 12$
6. $z = \frac{xy}{15}$	7. $y = \frac{3}{4}xz$	8. $y = \frac{1}{3}x$	9. $z = \frac{x}{12y}$	10. $y = \frac{x}{5}$

- **Write a function for each variation relationship:**

11. W varies directly as the square of d.

12. V varies inversely as J.

13. V varies inversely as p and directly as T.

14. F varies jointly as A and the square of v.

15. L varies directly as the fourth power of d and inversely as the square root of h.

Math 2 **Name_______________________________**
Unit 4 - Radical & Rational Functions **Date_________________________Pd______**
Lesson 5 → Types of Variations HOMEWORK

Write an equation for each statement and then solve:

1. If y $varies\ directly\ as\ x$ and $y = 15$ when $x = 3$, find y when $x = 12$.	2. If y $varies\ directly\ as\ x$ and $x = 36$ when $y = 4$, find x when $y = 24$.	3. If y $varies\ directly\ as\ x^2$ and $y = 12$ when $x = 4$, find y when $x = 6$.
4. If y $varies\ inversely\ as\ x$ and $y = 2$ when $x = 8$, find x when $y = 14$.	5. $If\ y\ varies\ inversely\ as\ x$ and $x = 7$ when $y = 21$, find y when $x = 42$.	6. If y $varies\ inversely\ as\ x^3$ and $y = 6$ when $x = \frac{-3}{4}$, find y when $x = 3$.
7. Suppose y $varies\ jointly\ with\ x\ and\ z$. If $y = 20$ when $x = 2$ and $z = 5$, find y when $x = 14$ and $z = 8$.	8. Suppose z $varies\ jointly\ with\ x\ and\ y$. If $x = 3$ and $y = 2$ when $z = 12$, find z when $x = 4$ and $y = 5$.	9. Suppose m $varies\ jointly$ as $n\ and\ p$. If $n = 4$ and $p = 5$ when $m = 60$, find m when $n = 12$ and $p = 2$.
10. Suppose that y $varies\ directly\ as\ x\ and\ inversely\ as\ z$. If $y = 5$ when $x = 3$ and $z = 4$, find y when $x = 6$ and $z = 8$.	11. Suppose y $varies\ directly\ as\ \sqrt{x}$ and $inversely\ as\ z$. If $y = 10$ when $x = 9$ and $z = 12$, find y when $x = 16$ and $z = 10$.	12. Suppose x $varies\ directly\ as\ y^3\ and\ inversely\ as\ \sqrt{z}$. If $x = 7$ when $y = 2$ and $z = 4$, find x when $y = 3$ and $z = 9$.

Determine the type of variation and then write an equation for each statement. Then solve.

13. The number (B) of bolts a machine can make $varies\ directly$ as the time (T) it operates. If the machine can make $6578\ bolts$ in $2\ hours$, how many bolts can it make in $5\ hours$?

14. The number of cooks needed to prepare lunch $varies\ inversely$ with the time. If it takes $9\ cooks\ four\ hours$ to prepare a school lunch, how long would it take $8\ cooks$ to prepare the lunch?

15. The current (I) in an electrical conductor $varies\ inversely$ as the resistance (r) of the conductor. If the current is $2\ amperes$ when the resistance in $960\ ohms$, what is the current when the resistance is $480\ ohms$?

16. Cheers $varied\ jointly$ as the number of fans and the **square** of the jubilation factor. If there were $100\ cheers$ when the number of fans was 100 and the jubilation factor was 4, how many cheers were there when there were only $10\ fans$ whose jubilation factor was 20?

17. The volume of a cone $varied\ jointly$ as the height of the cone and the area of the base. If a cone has a volume of $140\ cm^3$ when the height is $15\ cm$ and the area of the base is $28\ cm^2$, find the volume of a cone with a height of $7\ cm$ and a base area of $12\ cm^2$.

18. The number of girls $varies\ directly$ as the number of boys and $inversely$ as the number of teachers. When there were $50\ girls$, there were $10\ boys$ and $20\ teachers$. How many boys were there when there were $10\ girls$ and $100\ teachers$?

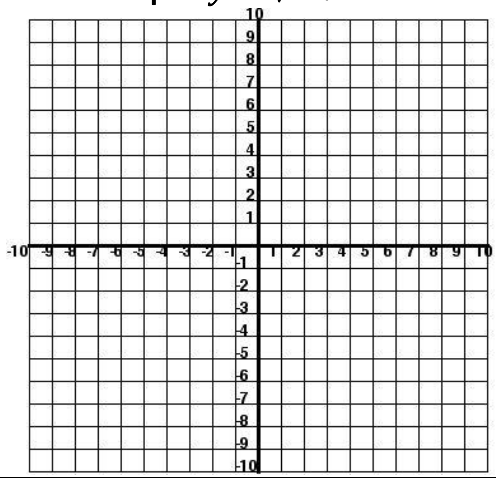
19. A pitcher's earned run average (ERA) $varies\ directly$ as the number of earned runs allowed and $inversely$ as the number of innings pitched. Joe Price had an ERA of 2.55 when he gave up 85 $earned\ runs\ in\ 300\ innings$. What would be his ERA if he gave up $120\ earned\ runs\ in\ 600\ innings$?

20. The maximum load that a cylindrical column with a circular cross section can hold $varies\ directly$ as the fourth power of the diameter and i$nversely$ as the square of the height. A $9\ meter\ column$ with a $2\ meter\ diameter$ will support $64\ metric\ tons$. How many metric tons can be supported by a column $9\ meters\ high$ and $3\ meters$ in $diameter$?

Math 2 Name__________________________________
Unit 4 – Test Review Date__________________________Pd______

I. Graph each of the following:

1. Graph: $y = \sqrt{x+4}$

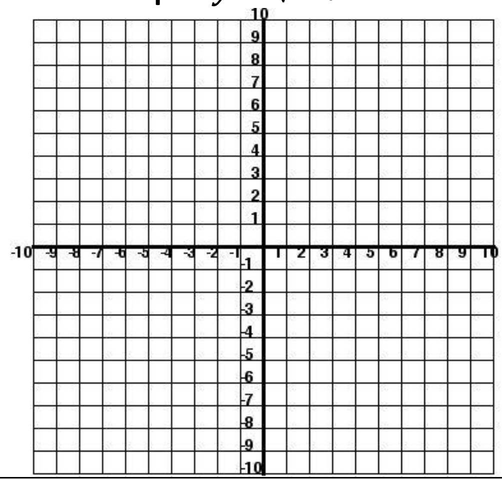


Vertex:

Domain:

Range:

2. Graph: $y = \sqrt{x+3} - 6$

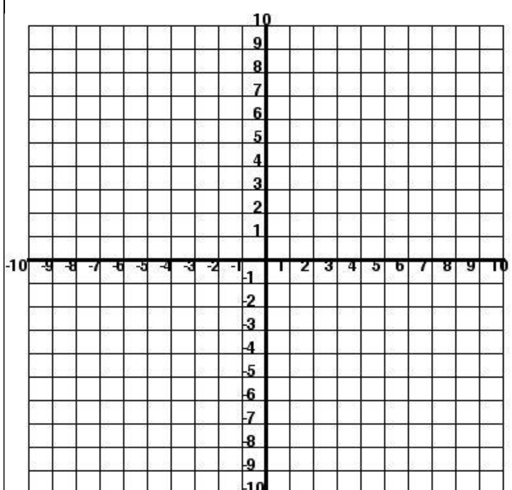


Vertex:

Domain:

Range:

3. Graph: $y = \sqrt[3]{x} + 2$

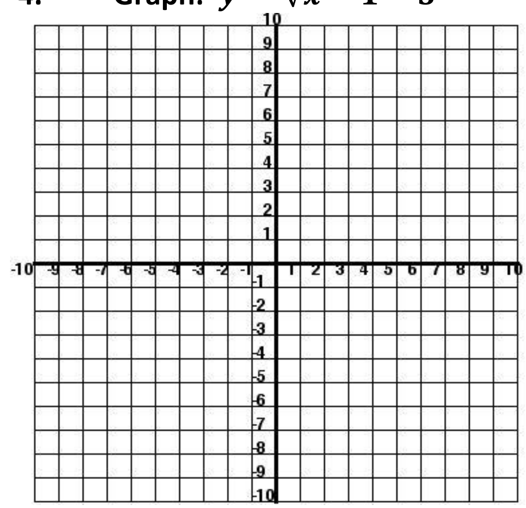


Vertex:

Domain:

Range:

4. Graph: $y = \sqrt[3]{x-1} - 3$

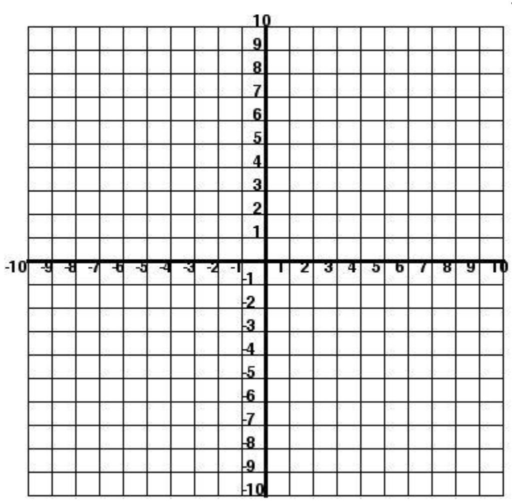


Vertex:

Domain:

Range:

5. Graph: $y = \frac{1}{x} + 2$

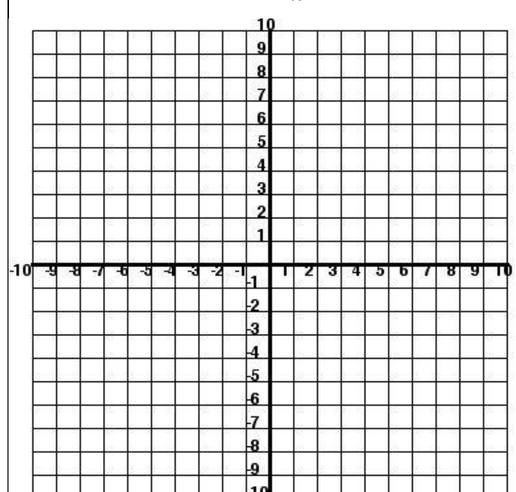


Vertex:

Domain:

Range:

6. Graph: $y = \frac{4}{x-1} - 3$



Vertex:

Domain:

Range:

II. Write the equivalent expression for each:

1. $x^{2/5}$	2. $5x^{3/2}$	3. $25^{-3/2}$	4. $(\sqrt[3]{x})^7$	5. $\sqrt{5x}$	6. $6\sqrt[5]{x^3}$

III. Solve each of the following square root equations:

1. $\sqrt{x} = 10$ $x =$ ________________	2. $\sqrt{3x+1} = 2$ $x =$ ________________	3. $\sqrt{2x-6} = \sqrt{x+5}$ $x =$ ________________
4. $5\sqrt{x} = 45$ $x =$ ________________	5. $\sqrt{x} + 4 = 6$ $x =$ ________________	6. $-4\sqrt{5x} + 1 = -7$ $x =$ ________________

IV. Solve each of the following rational equations:

7. $\frac{x+5}{2} = \frac{x}{3}$ $x =$ ________________	8. $\frac{1}{3} = \frac{3}{x-5}$ $x =$ ________________
9. $\frac{x+5}{2} - \frac{x}{3} = 4$ $x =$ ________________	10. $\frac{3}{x} + \frac{2x}{x+1} = 2$ $x =$ ________________

IV. Solve each variation problem:

11. Your distance from lightning **varies directly** with the time it takes you to hear thunder. If you hear thunder 10 sec. after you hear lightning, you are about 2 $miles$ from the lightning. About how many seconds would it take for thunder to travel a distance of 4 $miles$?	12. The drama club is planning a bus trip to NYC. The cost per person **varies inversely** as the number of people going on the trip. It will cost $30 per person if 44 people go on the bus. How much will it cost per person if 60 people go on the bus?