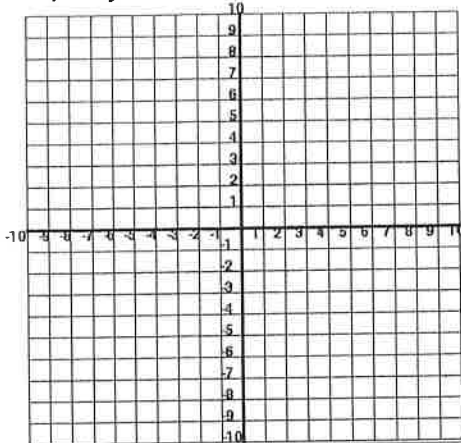


➤ Graphs of the Parent Functions:

Graph: $y = x^2$

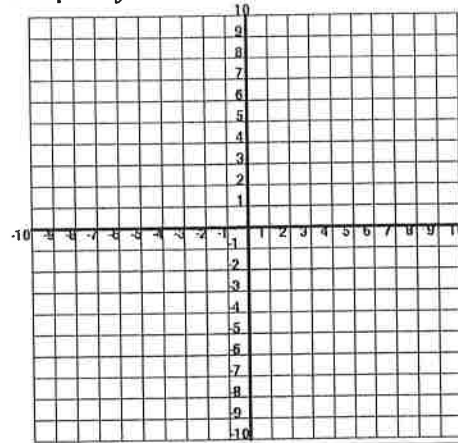


Vertex:

Domain:

Range:

Graph: $y = x^3$

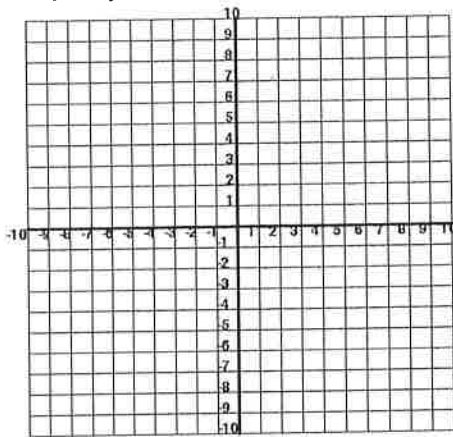


Vertex:

Domain:

Range:

Graph: $y = \sqrt{x}$

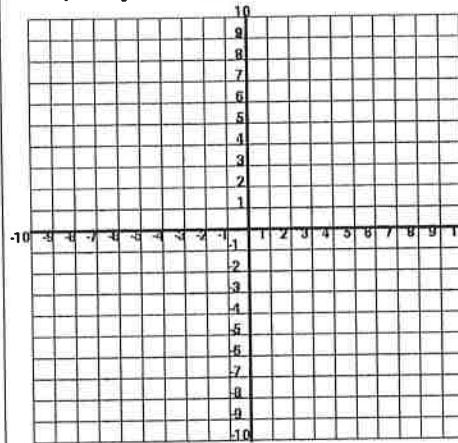


Vertex:

Domain:

Range:

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



Vertex:

Domain:

Range:

➤ Recall Transformation Rules:

$$y = a(x - h) + k$$

If a is negative, then the graph is a reflection across the x -axis

Vertical Stretch
 $|a| > 1$
 (makes it narrower)

Vertical Compression
 $0 < |a| < 1$
 (makes it wider)

Vertical Translation

Horizontal Translation
 (opposite of h)

Quadratic Function	Shift Left or Right	Shift Up or Down
$y = (x - 3)^2 + 6$		
$y = (x + 1)^2$		
$y = x^2 - 4$		
Square Root Function	Shift Left or Right	Shift Up or Down
$y = \sqrt{x - 2} + 5$		
$y = \sqrt{x} - 1$		
$y = \sqrt{x + 3}$		

Cubic Function	Shift Left or Right	Shift Up or Down
$y = (x + 2)^3 - 5$		
$y = x^3 + 7$		
$y = (x - 8)^3$		
Cube Root Function	Shift Left or Right	Shift Up or Down
$y = \sqrt[3]{x} - 9$		
$y = \sqrt[3]{x + 2} + 4$		
$y = \sqrt[3]{x - 8}$		

Math 2 – Honors
Unit 4 – Radical & Rational Functions
Lesson 3 → Square Root & Cube Root Equations

Name _____
Date _____ Pd _____

There are four steps to solving a radical equation:

- 1) Isolate the radical.
- 2) Raise both sides to the power of the root.
- 3) Solve for x.
- 4) Check for extraneous solution(s).

What is an **EXTRANEIOUS** solution? A solution to the final equation but not to the original equation. Extraneous solutions can occur when solving a **square root equation** but not when solving linear or quadratic equations.

➤ Examples:

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

$$10. \sqrt{3x+7} = x+1$$

$$11. (15-7x)^{1/2} = x-1$$

$$12. \sqrt{x+2} = 4 - \sqrt{x}$$

$$13. \sqrt{x} + 3 = \sqrt{x+4}$$

$$14. \sqrt{x+8} = \sqrt{x} + \sqrt{3}$$

$$15. \sqrt{x+3} = \sqrt{x+1} + 1$$

Lesson 3 → Square Root & Cube Root Equations HOMEWORK

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

11. $x = \sqrt{-10 + 7x}$

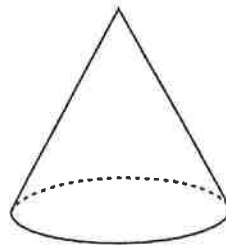
12. $\sqrt{2x - 7} = x - 3$

13. $x - 3 = \sqrt{37 - 3x}$

14. $\sqrt{3x - 11} = x - 5$

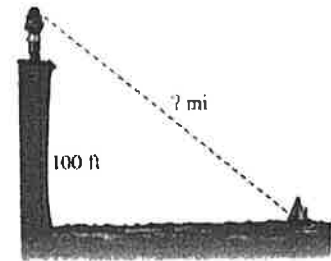
15. $\sqrt{3x - 2} = \sqrt{10 - x} + 2$

16. The surface area of a cone is found with the formula: $S = \pi r \sqrt{r^2 + h^2}$. Find h for the cone below of $S = 1884 \text{ cm}^2$ and $r = 6 \text{ cm}$.
Use $\pi = 3.14$



1. Did you ever stand on a beach and wonder how far out into the ocean you could see? Or have you wondered how close a ship has to be to spot land? In either case, the function $d(h) = \sqrt{2h}$ can be used to estimate the distance to the horizon (in miles) from a given height (in feet).

- a. Cordelia stood on a cliff gazing out at the ocean. Her eyes were 100 ft above the ocean. She saw a ship on the horizon. Approximately how far was she from that ship?



- b. From a plane flying at 35,000 ft, how far away is the horizon?

- c. Given a distance, d , to the horizon, what altitude would allow you to see that far? Rewrite the formula and solve for h .

2. A weight suspended on the end of a string is a *pendulum*. The most common example of a pendulum (this side of Edgar Allen Poe) is the kind found in many clocks. The regular back-and-forth motion of the pendulum is *periodic*, and one such cycle of motion is called a *period*. The time, in seconds, that it takes for one period is given by the radical equation, $t = 2\pi\sqrt{\frac{l}{g}}$ in which g is the force of gravity (10 m/s^2) and l is the length of the pendulum (*meters*).

- a. Find the period (to the nearest hundredth of a second) if the pendulum is 0.9 m long.

- b. Find the period if the pendulum is 0.049 m long.

- c. Solve the equation for length l .

- d. How long would the pendulum be if the period were exactly 1 second?

3. The current (in ampere) a machine need to reach a certain power can be modeled by the equation, $I = 0.2\sqrt{P}$, where P is the power of machine in watts. If the current is 10 amperes, what is the power of machine in watts?

4. When a car comes to a sudden stop, you can determine the skidding distance (in feet) for a given speed (in miles per hour) using the formula, $s(x) = 2\sqrt{5x}$, in which s is skidding distance and x is speed. Calculate the skidding distance for the following speeds (round to nearest tenth of a foot).
- 55 *mph*
 - 65 *mph*
 - 75 *mph*
 - 40 *mph*
 - Given the skidding distance s , what formula would allow you to calculate the speed, x , in *mph*?
 - Use the formula obtained in (e) to determine the speed of a car in miles per hour if the skid marks were 35 *ft* long.

Write an equation and then solve each of the following applications.

- The sum of an integer and its square root is 12. Find the integer.
- The difference between an integer and its square root is 12. What is the integer?
- The sum of an integer and twice its square root is 24. What is the integer?
- The sum of an integer and 3 times its square root is 40. Find the integer.

Math 2 – Honors
 Unit 4 – Radical & Rational Functions
 Lesson 5 → Graphs of Rational Functions

Name _____
 Date _____ Pd _____

➤ 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: $y = \frac{n}{x-h} + k$

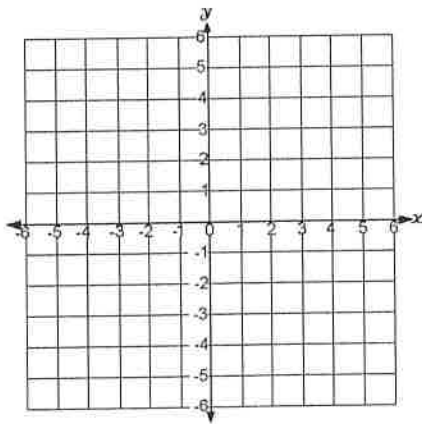
- 1) Determine the location of the asymptotes based on the transformations:
 - A) Vertical asymptotes are placed based on the **horizontal translation**: $x = h$
 - B) Horizontal asymptotes are placed based on the **vertical translation**: $y = k$
- 2) **Vertical Stretch or Compression**: n tells us 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 = \sqrt{n}

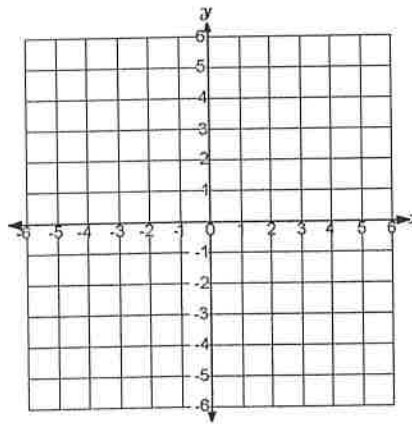
3) Look at the table on the calculator for other points and then sketch the two branches.

❖ Graph each of the following examples:

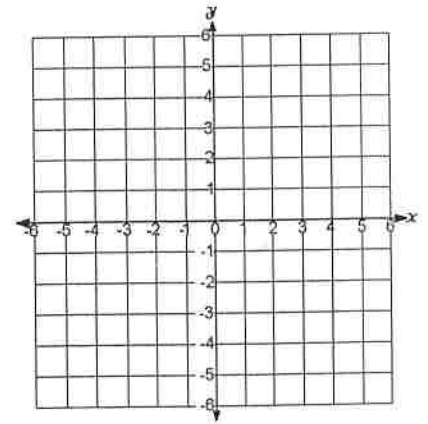
1. $y = \frac{1}{x}$



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



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

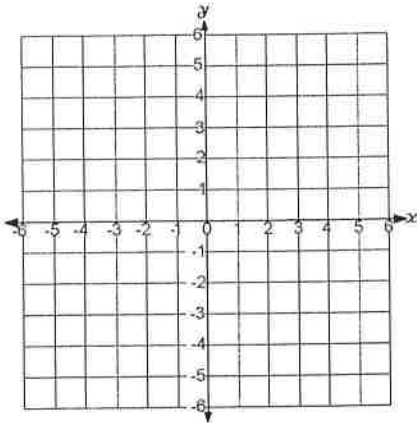


Equation of VA:
 Equation of HA:
 Describe translations:
 Domain:
 Range:

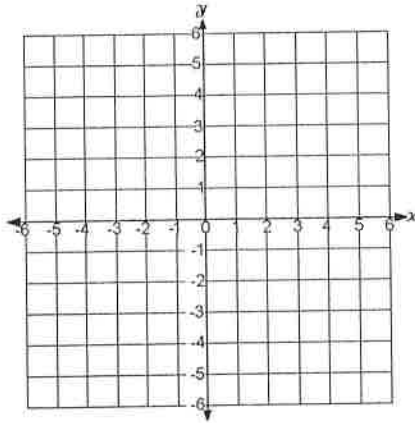
Equation of VA:
 Equation of HA:
 Describe translations:
 Domain:
 Range:

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

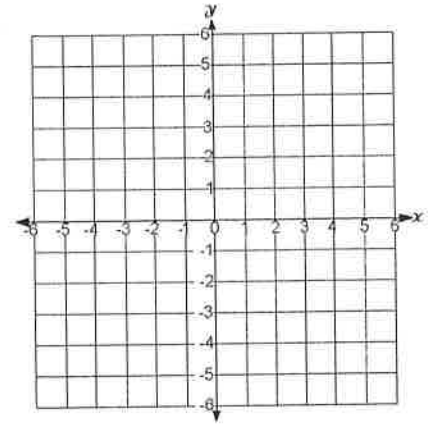
4. $y = \frac{1}{x} - 4$



5. $xy = 9$



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



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

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

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

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

<p>$y = \frac{-2}{x-7} + 5$</p> <p>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 _____.</p>	<p>$y = \frac{7}{x+2} - 4$</p> <p>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 _____.</p>
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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 – Honors
Unit 4 – Radical & Rational Functions
Lesson 6 → Rational Equations

Name _____
Date _____ Pd _____

- **Recall:** 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 $q(x) \neq 0$
- 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. $\frac{6}{x} = \frac{3}{7}$

2. $\frac{4}{x-7} = \frac{6}{x}$

3. $\frac{-5}{x+4} = \frac{1}{x+4}$

4. $\frac{4}{x+5} = \frac{x}{6}$

5. $\frac{x-4}{4} + \frac{x}{3} = 6$

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

7. $\frac{6}{x} = \frac{1}{4} + \frac{9}{x-1}$

8. $\frac{2x}{x-1} + \frac{x-5}{(x-1)(x+1)} = 1$

Math 2 – Honors
Unit 4 – Radical & Rational Functions
Lesson 6 → Rational Equations HOMEWORK

Name _____
Date _____ Pd _____

➤ Solve for x:

1. $\frac{3}{x} = \frac{2}{x+4}$

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

3. $\frac{3}{x+2} + 5 = \frac{4}{x+2}$

4. $\frac{6}{x-3} = \frac{x}{18}$

5. $\frac{5x}{x+2} + \frac{2}{x} = 5$

6. $\frac{2x-3}{7} - \frac{x}{2} = \frac{x+3}{14}$

$$7. \frac{4x}{3x-2} + \frac{2x}{3x+2} = 2$$

$$8. \frac{5}{5-x} - \frac{x^2}{5-x} = -2$$

$$9. \frac{2x-5}{x-2} - 2 = \frac{3}{x+2}$$

$$10. \frac{4}{(x-2)(x-6)} = \frac{x}{x-2} + \frac{1}{x-6}$$

➤ **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 – Honors
 Unit 4 - Radical & Rational Functions
 Lesson 7 → Types of Variations HOMEWORK

Name _____
 Date _____ Pd _____

Write an equation for each statement and then solve:

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

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 is 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 *inversely* 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 - Honors
 Unit 4 Radical & Rational Functions
 Test Review

Name _____
 Date: _____ PD: _____

➤ Write each expression in **simplest radical form**

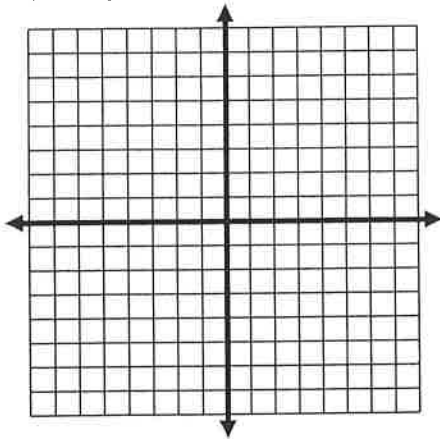
1. $7^{1/2}$	2. $x^{-2/3}$	3. $5y^{2/3}$	4. $(7x)^{1/4}$	5. $36^{-1/2}$
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➤ Write each expression in **exponential form**:

6. $\sqrt{5}$	7. $\sqrt[4]{2x}$	8. $\sqrt[3]{x^2}$	9. $3\sqrt[5]{x^3}$	10. $\frac{1}{\sqrt{11}}$
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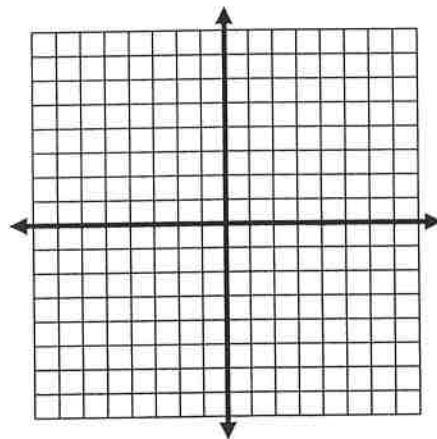
➤ **Graph each function. Then state the Domain & Range.**

1) $y = \sqrt{x} - 1$



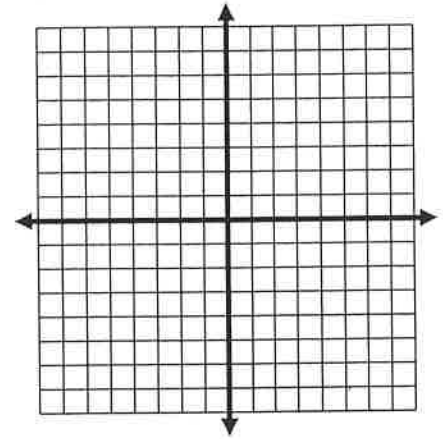
D: _____ R: _____

2) $f(x) = -\sqrt{x+2} - 4$



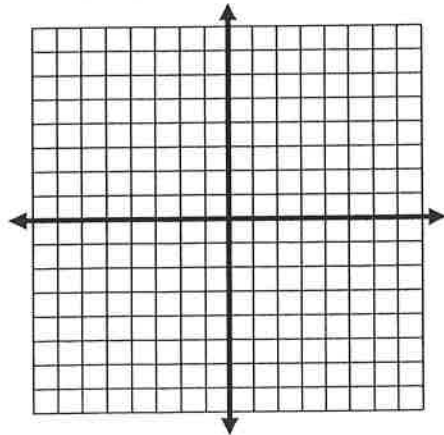
D: _____ R: _____

3) $y = \sqrt[3]{x} + 2$



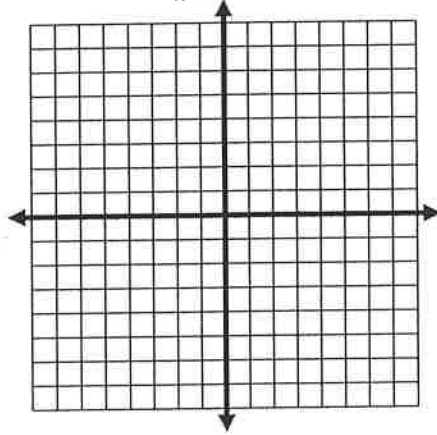
D: _____ R: _____

4) $f(x) = \sqrt[3]{x+1} + 2$



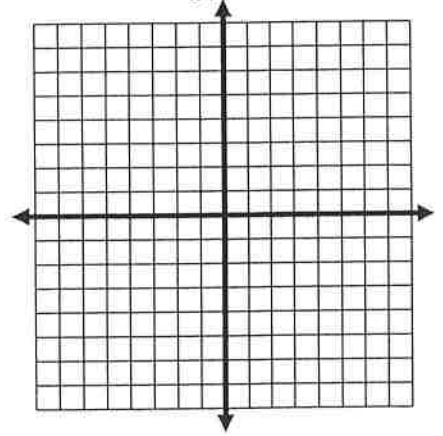
D: _____ R: _____

5) $f(x) = \frac{4}{x+2} - 3$



D: _____ R: _____

6) $f(x) = \frac{-1}{x+3} + 1$



D: _____ R: _____

7) Write the equation of a square root function that has been translated four units left and five units down and reflected across the x -axis.

8) Write the equation of a rational function that has a domain of $x \neq 2$ and a range of $y \neq -4$ with a vertical stretch of 9.

Solve each equation. Be sure to check for extraneous solutions!!

9) $\sqrt{x+10} - 7 = -5$	10) $\sqrt{-3x+40} = x$	11) $\sqrt{x+14} = x - 16$
12) $\frac{-2}{x+4} = \frac{4}{x+3}$	13) $\frac{x+4}{x-2} = \frac{x-5}{x-8}$	14) $\frac{5}{6x} + \frac{1}{x} = 4$
15) $\frac{2}{(x-1)(x+1)} - 1 = \frac{1}{x-1}$	16) Your distance from lightning <i>varies directly</i> with the time it takes you to hear thunder. If you hear thunder 10 <i>seconds</i> after you see lightning, you are about 2 <i>miles</i> from the lightning. About how many seconds would it take for thunder to travel a distance of 4 <i>miles</i> ?	17) The drama club is planning a bus trip to New York City. The cost per person <i>varies inversely</i> as the number of people going on the trip. It will cost \$30 per person if 44 <i>people</i> go on the trip. How much will it cost per person if 60 <i>people</i> go on the trip?
18) For a given interest rate, simple interest <i>varies jointly</i> as principal and time. If \$2000 left in an account for 4 <i>years</i> earns interest of \$320, how much interest would be earned in if you deposit \$5000 for 7 <i>years</i> ?	19) The volume of gas <i>varies directly</i> as the temperature and <i>inversely</i> as the pressure. If the volume is 230 <i>cubic centimeters</i> when the temperature is 300°K and the pressure is 20 <i>pounds</i> per square centimeter, what is the volume when the temperature is 270°K and the pressure is 30 <i>pounds</i> per square centimeter?	20) A. In a thunderstorm, the wind velocity in <i>meters per second</i> can be described by the function, $v(p) = 5.7\sqrt{998 - p}$ where p is the air pressure in millibars. What is the wind velocity if the air pressure is 437 <i>millibars</i> ? B. What is the air pressure of a thunderstorm in which the wind velocity is 49.3 <i>meters per second</i> ?