

Supplementary Trig Material

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Solutions

Lesson A Solving Equations with Radicals and Absolute Value

Solving Equations with Absolute Value Recall that when the absolute value bars are employed, the value inside becomes positive, whether it is positive or negative to begin with.

$$| -2 | = +2 \text{ or } 2, \text{ and } | +2 | = +2 \text{ or } 2.$$

So if $|X| = A$, then $X = A$ or $X = -A$, because in either case the answer is $+A$ or just A .

Example 1

$$|X| = 3 \text{ Find the solutions.}$$

If $|X| = 3$, then $X = +3$ or $X = -3$, and the solution is $X = \pm 3$.

Example 2

$$|X + 1| = 5 \text{ Find the solutions.}$$

Building on Example 1, $(X + 1) = \pm 5$.

$$X + 1 = 5 \quad \text{or} \quad X + 1 = -5$$

$$X = 4 \qquad X = -6$$

Fairness Rule for Solving Equations with Radicals You can raise both sides of an equation to the same power without changing the value of the equation. This is expressed as: If $A = B$ then $A^X = B^X$.

Example 3

$$\text{Solve } \sqrt{X} = 2$$

$$(\sqrt{X})^2 = (2)^2$$

$$X = 4$$

Square both sides, or raise them both to the second power.

Example 4

$$\text{Solve } \sqrt{X+1} = 2$$

$$(\sqrt{X+1})^2 = 2^2$$

$$X+1 = 4$$

$$X = 3$$

Square both sides, or raise them both to the second power.

Example 5

$$\text{Solve } \sqrt{X+1} + 2 = 3$$

$$\sqrt{X+1} = 5$$

Remove all non-radicals to one side of the equation.

$$(\sqrt{X+1})^2 = 5^2$$

$$X+1 = 25$$

$$X = 24$$

Apply the correct power to both sides of the equation to "free" the radical.

Example 6

Solve $\sqrt[3]{X-2} = 2$

Apply the correct power to both sides of the equation.

$$X-2 = 8$$

$$X = 10$$

Check: $\sqrt[3]{10-2} = 2$

Example 7

Solve $\sqrt[4]{2X+41} = 3$

Apply the correct power to both sides of the equation.

$$2X+41 = 81$$

$$2X = 40$$

$$X = 20$$

Check: $\sqrt[4]{40+41} = 3$
 $\sqrt[4]{81} = 3$

Example 8

Extraneous solutions are possible! So check all of your solutions to see if they truly satisfy the equation.

Solve $\sqrt{2X-1} - 2 = \sqrt{X}$

Apply the correct power to both sides of the equation.

$$(\sqrt{2X-1} - 2)^2 = (\sqrt{X})^2$$

$$2X-1-4\sqrt{X}+X = X$$

$$(X-5)^2 = (4\sqrt{X})^2$$

$$X^2 - 10X + 25 = 16X$$

$$X^2 - 26X + 25 = 0$$

$$(X-25)(X-1) = 0$$

$$X = 1 \text{ or } X = 25$$

Check:

$$\sqrt{49} - 2 = \sqrt{25}$$

$$5 - 2 = 5$$

No

Check:

$$\sqrt{1} - 2 = \sqrt{1}$$

$$1 - 2 = 1$$

Yes

Answer: $X = 1$

Example 9

Solve $|X+3| = -2$

In this case you can work all day and never find a value for X that will work. The left side of the equation must be positive, and the right is negative.

Answer: No Solutions

Be careful. Certain standardized tests enjoy throwing this kind of problem at unsuspecting students.

Solve for X .

1) $|X| = 6$

2) $|X+4| = 7$

3) $|X - 8| = 3$

4) $|X+9| = -4$

5) $|X - 4| = -3$

6) $|X+2 - 3| = 2$

Solve for X by raising both sides of the equation to the same power. Check each solution.

7) $\sqrt{X} = 3$

8) $\sqrt[3]{X} = 2$

9) $\sqrt{X+3} = 4$

10) $\sqrt{X+4} - 3 = 6$

11) $\sqrt{X - 2} + 7 = 11$

12) $\sqrt[3]{X+2} + 4 = 7$

13) $\sqrt[4]{2X+8} - 1 = 1$

14) $\sqrt[3]{X+2} = 9 - 8$

15) $\sqrt{2X - 4} - 4 = -\sqrt{X}$

Solve for X.

1) $|X| = 8$

2) $|X+9| = 2$

3) $|X - 5| = -6$

4) $|X+1| = 9$

5) $|X+3+4| = 5$

6) $|X - 8+2| = 16$

Solve for X by raising both sides of the equation to the same power. Check each solution.

7) $\sqrt{X} = 4$

8) $\sqrt[3]{X} = 1$

9) $\sqrt{X+2} = 3$

10) $\sqrt{X - 1} + 5 = 10$

11) $\sqrt{X+4} - 3 = 1$

12) $\sqrt[3]{X - 2} - 9 = -7$

13) $\sqrt[4]{2X+1} + 11 = 14$

14) $\sqrt[3]{X+1} + 8 = -5 + 20$

15) $\sqrt{2X - 2} - 1 = \sqrt{3X}$

Lesson B Solving Inequalities with Absolute Value and Radicals

Solving Inequalities with Absolute Value

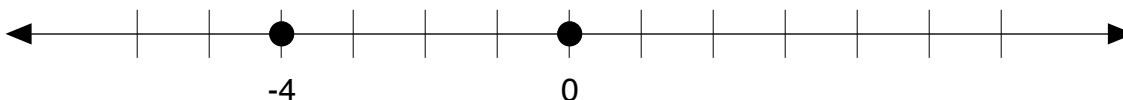
When the absolute value bars are employed, the value inside becomes positive, whether it is positive or negative to begin with. Solving inequalities with absolute value is a two-step process. First you solve the equality, then you solve for the inequality.

Example 1 $|X+2| < 2$

Step 1: Begin by solving this equation as if the problem was an equation or equal.

The expression $X+2$ inside the absolute bars can be either $+2$ or -2 , since the absolute value bars would make it $+2$. So we have 2 possibilities: $X + 2 = 2$ and $X + 2 = -2$.

$$\begin{array}{l} |X+2| = 2 \\ X+2 = 2 \quad \text{or} \quad X+2 = -2 \\ X = 0 \quad \quad \quad X = -4 \end{array}$$

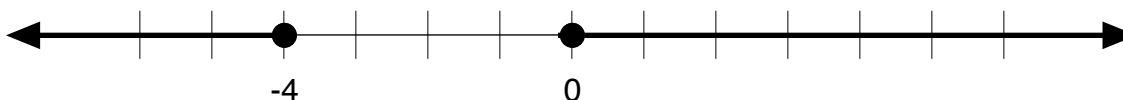


Since this is an equality as well as an inequality, the circles at those answers are darkened.

Step 2: Now we will determine whether the correct answers fall between those points, or outside those points. We choose test numbers in all 3 regions: (-5) , (-1) , and $(+1)$.

$X = 5$	$ 5+2 < 2$	True
$X = -1$	$ -1+2 < 2$	False
$X = -5$	$ -5+2 < 2$	True

Since (-5) and $(+1)$ are true, they are part of the solution and we see that the answers lie outside those points for the given inequality.



Be careful: Sometimes these problems are tricky.

Example 2

$$|3X - 2| - 2 < 3 \quad \text{Add } +2 \text{ to both sides of the inequality.}$$

$$|3X - 2| < 1$$

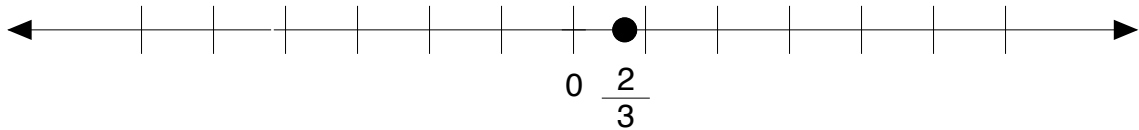
There are no solutions here. We have positive on the left side, as a result of absolute value, but negative (< 0) on the right side.

Example 3

$$|3X - 2| = 0$$

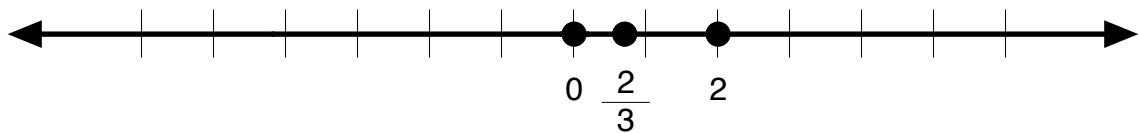
$$|3X - 2| = 0$$

$$X = \frac{2}{3}$$



Check on both sides:

$X = 0$	$ 2 = 0$	True
$X = 2$	$ 4 = 0$	True



All solutions work on this one. But we could have figured this out by stepping back from the problem and seeing that since absolute value is always positive or " > 0 ", then anything inside the absolute value bars will be positive.

$$| \text{anything} | > 0 \text{ or } |3X - 2| > 0 .$$

Solving Inequalities with Radicals Recall the Fairness Rule for Solving Equations with Radicals. You can raise both sides of an equation to the same power without changing the value of the equation. This is expressed as: If $A = B$, then $A^X = B^X$.

Example 4

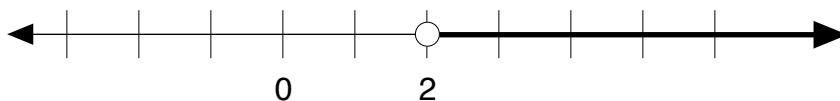
$$\sqrt{X+2} > 2$$

$$X+2 > 4$$

$$X > 2$$

Raise both sides to the 2nd power.

Subtract 2 from both sides.



Be careful to check all your solutions. Absolute value and radical problems are notorious for extraneous solutions.

Check on both sides:

$$X = 0$$

$$\sqrt{0+2} > 2$$

False

$$\sqrt{2} > 2$$

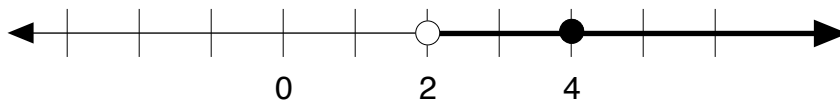
$$X = 4$$

$$\sqrt{4+2} > 2$$

True

$$\sqrt{6} > 2$$

$$2.8 > 2$$

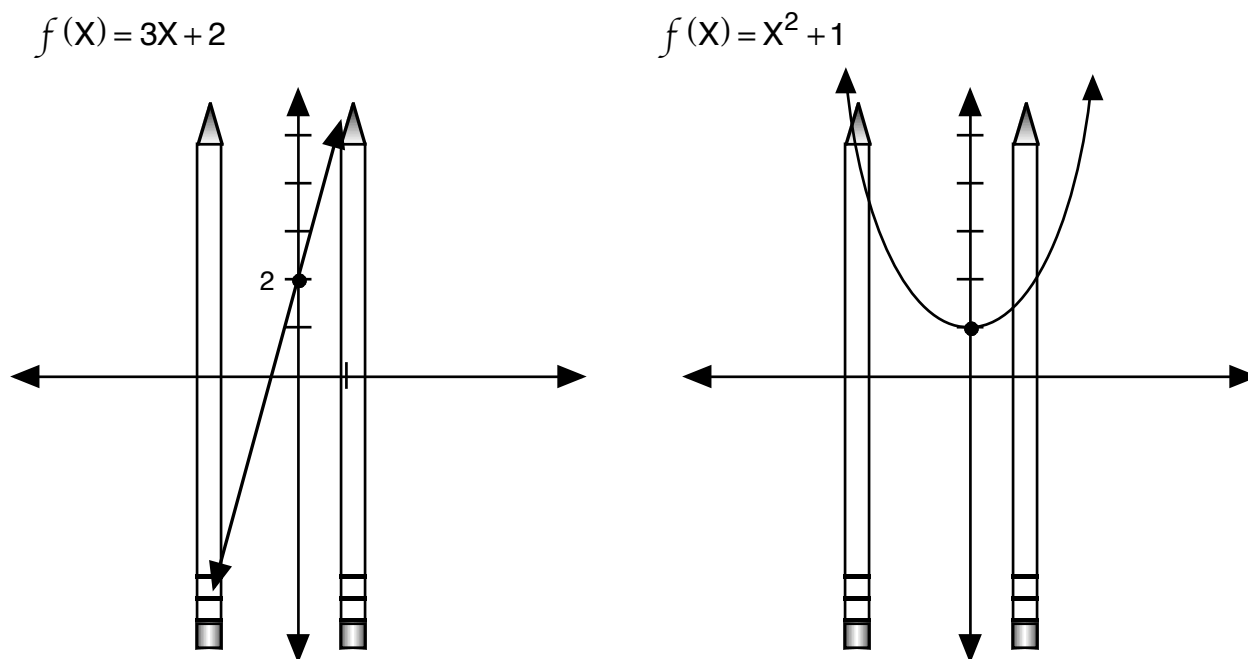


Lesson C Functions

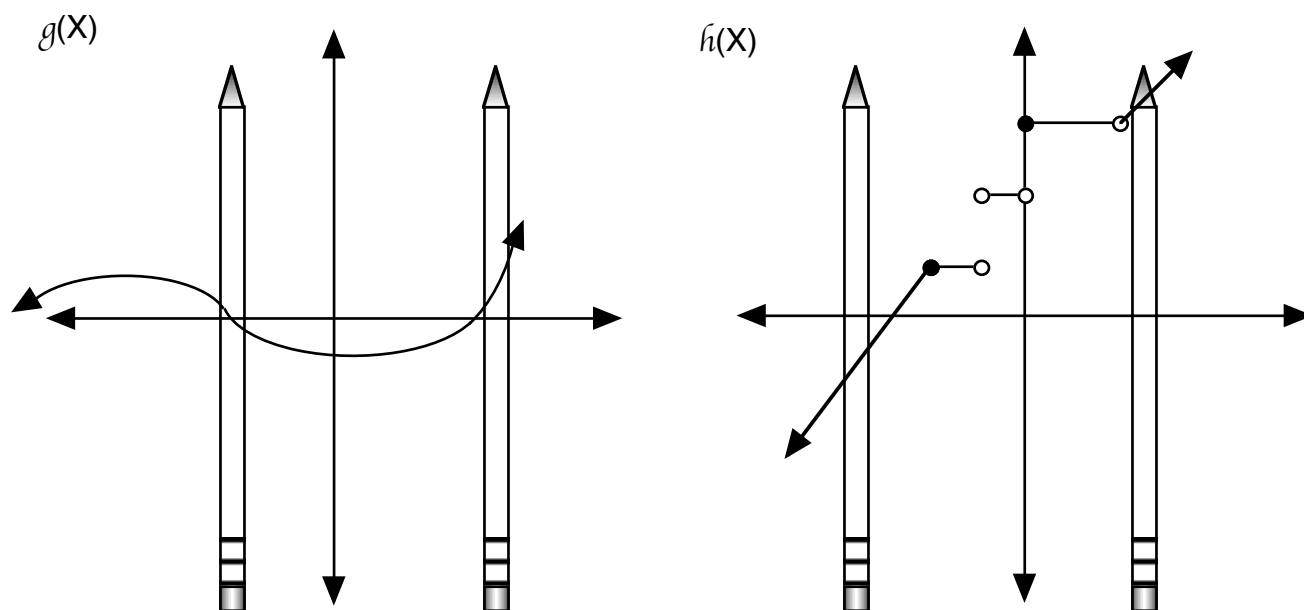
You are accustomed to seeing equations like $Y = 3X + 2$ and $Y = X^2 + 1$. These equations express solutions where each value of X has one and only one corresponding value of Y . In the equation $Y = 3X + 2$, if $X = 5$, then $Y = 17$. If $X = -2$, $Y = -4$. In $Y = X^2 + 1$, if $X = 3$, then $Y = 10$. If $X = -3$, $Y = 10$. We refer to the equations where this relationship between the X and Y values is true, as functions. The symbol f is used to denote functions and $f(x)$ is referred to as the “function of X ”. Instead of $Y = 3X + 2$ and $Y = X^2 + 1$, many texts rewrite these equations as:

$$f(X) = 3X + 2 \text{ and } f(X) = X^2 + 1$$

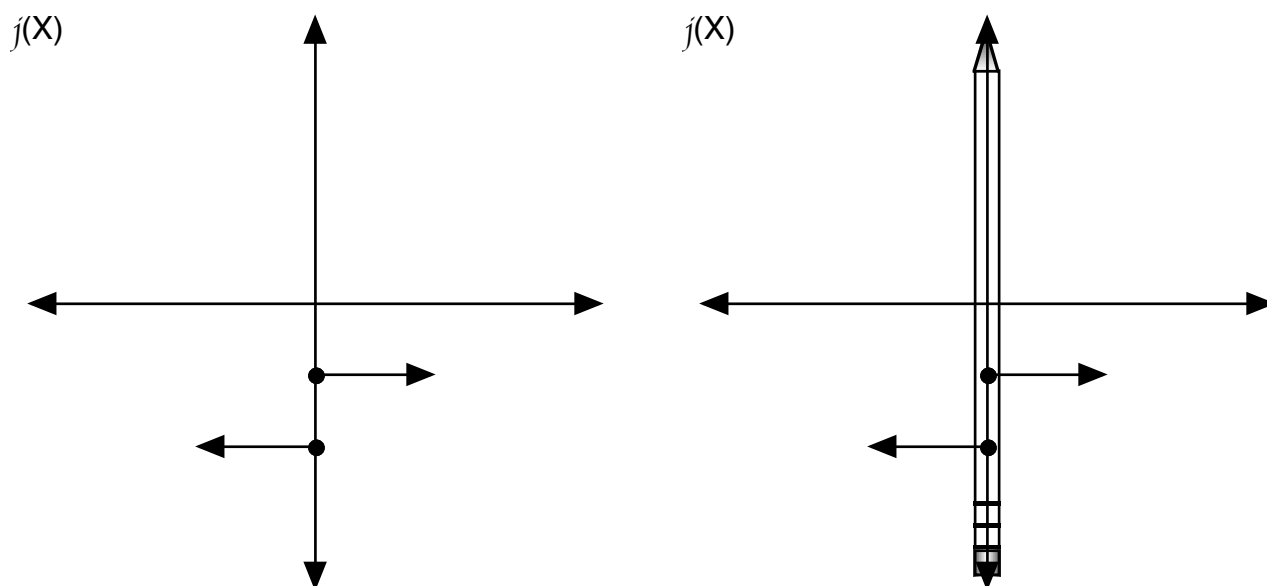
In these cases $f(X)$ can be thought of as a replacement for Y . Indeed, the value of Y , or $f(X)$, depends on the value of X . If the value of X changes, then so does the value of Y .



The easiest way to determine whether a relationship is a function or not, is with the vertical line test. Pick up your pencil and place it vertically on the graph. If it touches in only one point in every possible vertical position, then you have a function. As you move your pencil you are changing the value of X . If it only touches one point, then there is only one value of Y for each value of X .

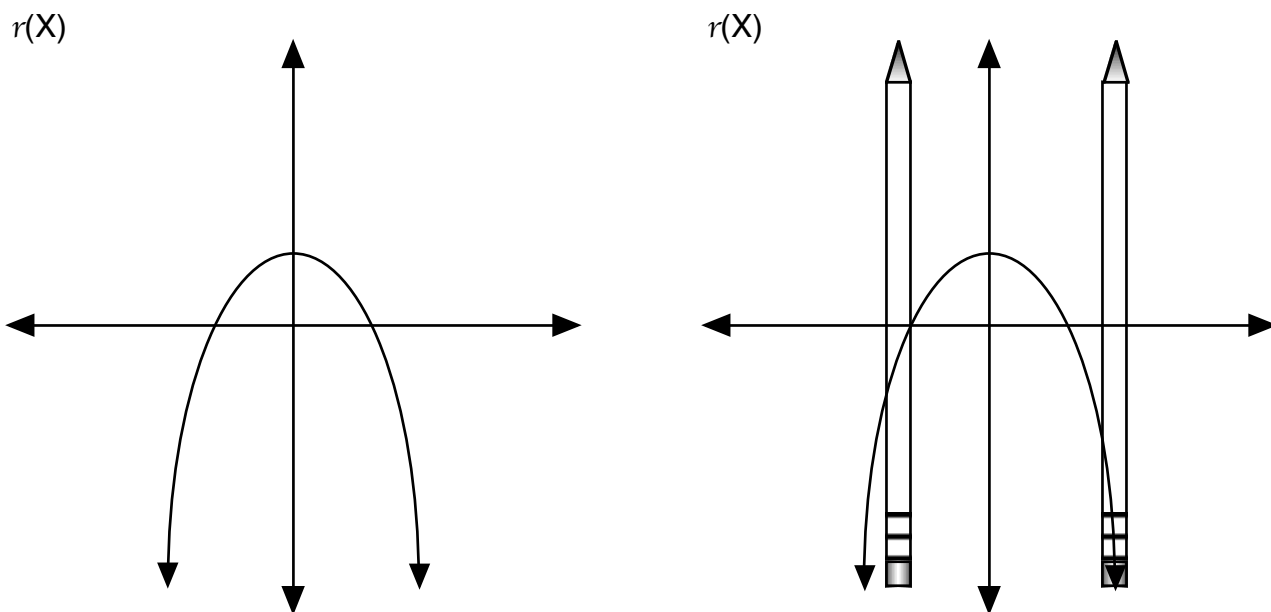


$g(X)$ and $h(X)$ are functions, because they pass the vertical line test.

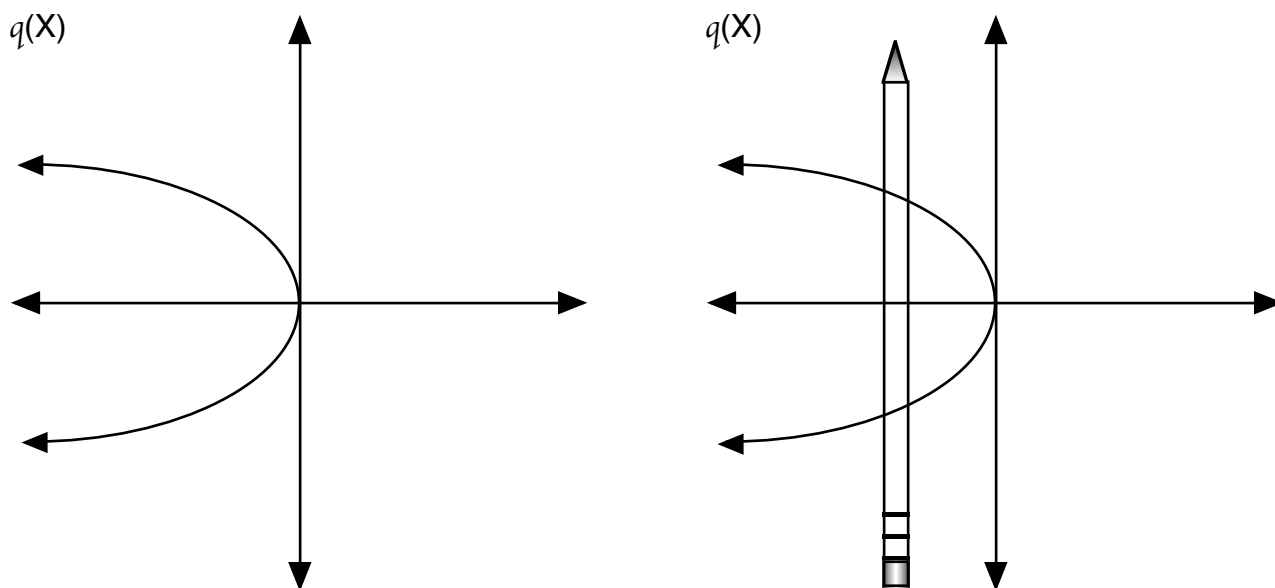


$j(X)$ is not a function. It does not pass the vertical line test. When $X = 0$, there are two Y values instead of the required one. When $X = 0$, $j(X)$ is 3 and 4 at the same time.

$r(X)$ is a function, because it passes the vertical line test for all values of X .



$q(X)$ is not a function, because it fails for all negative values of X . For example, if X is -2 , then Y could be $+2$ or -2 . But for each value of X there must only be one corresponding value of Y or $q(X)$.



The domain of a function is a set of values which represents all the possible values X may have in that function.

The range is the possible set of solutions or values which $f(X)$ may have in that function. If you see $\{ , + \}$, this means from negative infinity to positive infinity, or all the negative and positive values. On a graph this represents a line moving infinitely in both directions. If you see $\{0, + \}$ or $\{0, \}$, then it includes all the positive values starting at 0. This would be drawn as a ray with endpoint 0 moving to infinity.

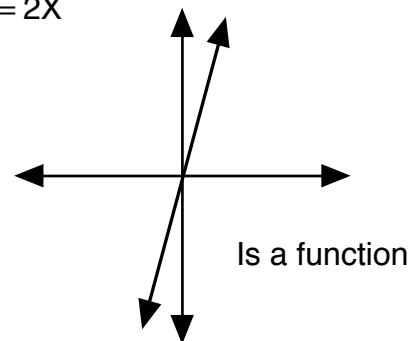
Example 1 $f(X) = 2X$

Is this a function? What are the domain (X values) and range (Y or $f(X)$ values)?

Domain: $(,)$ or all real numbers

Range: $(,)$ or all real numbers

$f(X) = 2X$



Example 2 $f(X) = |X|$

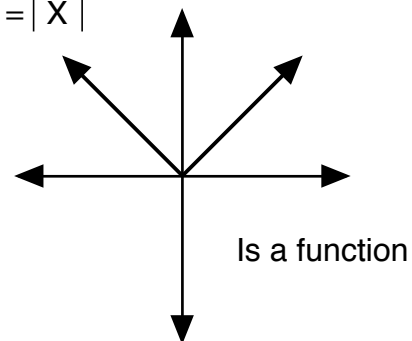
Is this a function? What are the domain and range?

Domain: $(,)$ or all real numbers

Range: $[0,)$ or all values ≥ 0

(The square bracket at either end of a domain or range indicates that the value at that end is included.)

$f(X) = |X|$



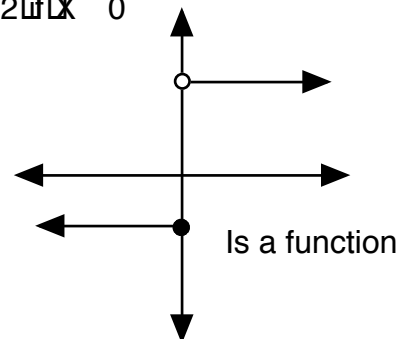
Example 3 $f(X) = \begin{cases} 1 & \text{if } X < 0 \\ 2 & \text{if } X \geq 0 \end{cases}$

Is this a function? What are the domain and range?

Domain: $(,)$ or all real numbers

Range: -1 or 2

$f(X) = \begin{cases} 1 & \text{if } X < 0 \\ 2 & \text{if } X \geq 0 \end{cases}$

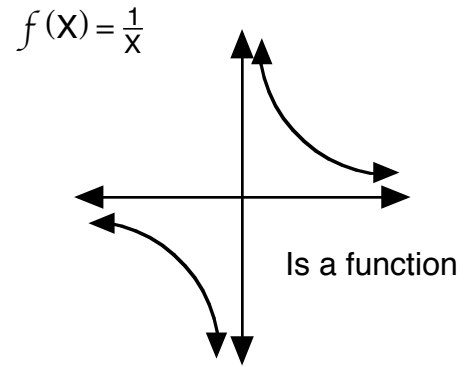


Example 4 $f(x) = \frac{1}{x}$

Is this a function? What are the domain and range?

Domain: $(-\infty, 0) \cup (0, \infty)$ or all non-zero numbers

Range: $(-\infty, 0) \cup (0, \infty)$ or all non-zero numbers



0 is excluded from the x values and the $f(x)$ values because x can never be 0. If $x = 0$, then $1/x$ would be $1/0$ which is not possible and hence undefined.

Another way to represent the domain and range would be to state that x and y can be any value except 0.

Evaluating Functions by Substitution

Remember that a function is simply another way of solving for y . When you see $f(x)$ it may be helpful to think of substituting other values for x and seeing the result. I was taught that $f(x)$ represented a function machine, and when I threw in another value for x it processed that value and produced a new answer. If the function machine is $2x + 1$, then whatever value I choose for x is thrown into the machine and multiplied by 2, then 1 is added to it. So if $x = 3$, then $2(3) + 1$ is 7. Observe the following examples.

Example 5

$$f(x) = 3x - 4$$

$$f(5) = 3(5) - 4 = 15 - 4 = 11$$

$$f(100) = 3(100) - 4 = 300 - 4 = 296$$

$$f(-2) = 3(-2) - 4 = -6 - 4 = -10$$

$$f(\sin x) = 3\sin x - 4$$

Example 6

$$f(x) = -4x + 15$$

$$f(5) = -4(5) + 15 = -20 + 15 = -5$$

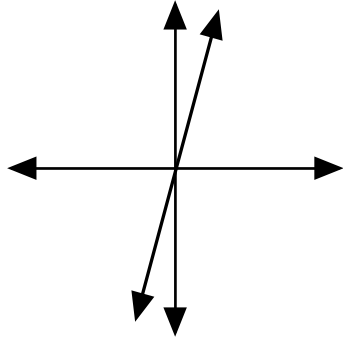
$$f(100) = -4(100) + 15 = -400 + 15 = -385$$

$$f(-2) = -4(-2) + 15 = 8 + 15 = 23$$

$$f(\sin x) = -4\sin x + 15$$

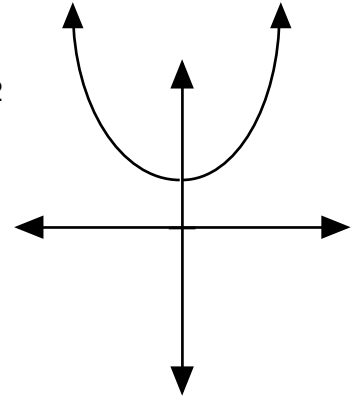
Answer the questions for each drawing. If the drawing is not a function, write NA after the questions about domain and range.

$$f(X) = 3X$$



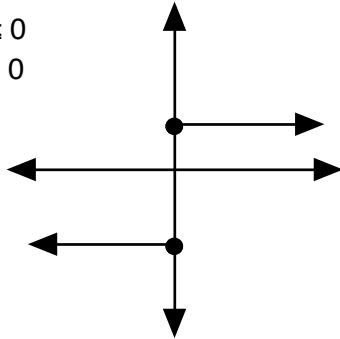
- 1) Is this a function?
- 2) What is the domain?
- 3) What is the range?

$$f(X) = X^2 + 2$$



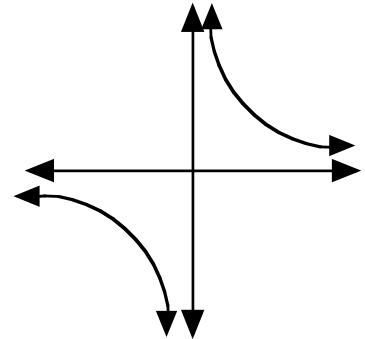
- 4) Is this a function?
- 5) What is the domain?
- 6) What is the range?

$$f(X) = \begin{cases} -2 & \text{if } X \leq 0 \\ 1 & \text{if } X \geq 0 \end{cases}$$



- 7) Is this a function?
- 8) What is the domain?
- 9) What is the range?

$$f(X) = \frac{3}{X}$$



- 10) Is this a function?
- 11) What is the domain?
- 12) What is the range?

Evaluate each function by substituting -3 for X.

$$13) f(X) = 6X - 1$$

$$14) f(X) = X^2 + 5$$

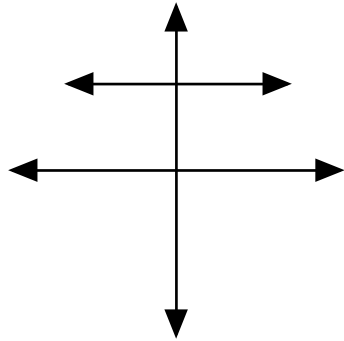
Evaluate each function again by substituting 20 for X.

$$15) f(X) = 6X - 1$$

$$16) f(X) = X^2 + 5$$

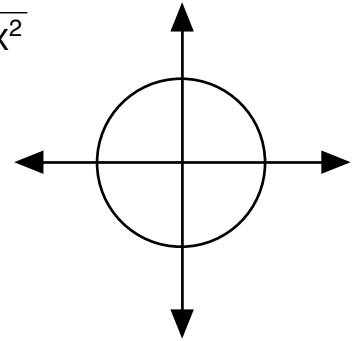
Answer the questions for each drawing. If the drawing is not a function, write NA after the questions about domain and range.

$$f(X) = 4$$



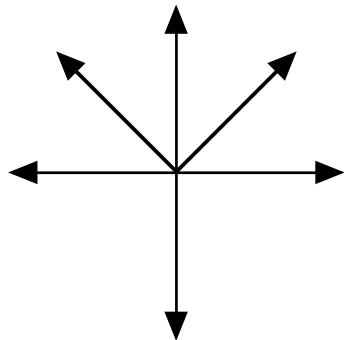
- 1) Is this a function?
- 2) What is the domain?
- 3) What is the range?

$$f(X) = \sqrt{9 - X^2}$$



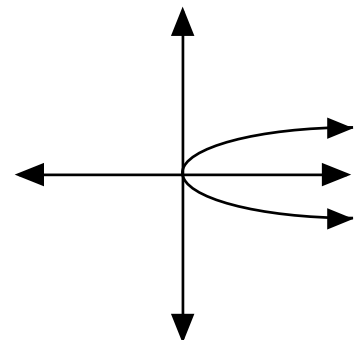
- 4) Is this a function?
- 5) What is the domain?
- 6) What is the range?

$$f(X) = |X|$$



- 7) Is this a function?
- 8) What is the domain?
- 9) What is the range?

$$f(X) = \sqrt{X}$$



- 10) Is this a function?
- 11) What is the domain?
- 12) What is the range?

Evaluate each function by substituting 0 for X.

$$13) f(X) = X + 1$$

$$14) f(X) = 2X^2 + 8$$

Evaluate each function again by substituting -5 for X.

$$15) f(X) = X + 1$$

$$16) f(X) = 2X^2 + 8$$

Lesson D Composite Functions

Now we are going to use what we know about functions to use more than one function at a time. The following examples will illustrate addition, subtraction, multiplication, division, and a function of a function. The two functions we will use are $f(X)$ and $g(X)$.

$$f(X) = 2X + 3 \qquad g(X) = X^2$$

Example 1 The Sum of Two Functions

$$f(X) + g(X) = [2X + 3] + [X^2] = X^2 + 2X + 3$$

Example 2 The Difference of Two Functions

$$f(X) - g(X) = [2X + 3] - [X^2] = -X^2 + 2X + 3$$

$$g(X) - f(X) = [X^2] - [2X + 3] = X^2 - 2X - 3$$

Example 3 The Product of Two Functions

$$(f \cdot g)(X) = (2X + 3)(X^2) = 2X^3 + 3X^2$$

Example 4 The Quotient of Two Functions

$$(f / g)(X) = (2X + 3)/(X^2) = \frac{2X + 3}{X^2}$$

$$(g / f)(X) = (X^2)/(2X + 3) = \frac{X^2}{2X + 3}$$

Example 5 The Function of a Function

$$f(g(X)) = (2(X^2) + 3) = 2X^2 + 3$$

$$g(f(X)) = ((2X + 3)^2) = 4X^2 + 12X + 9$$

Given the following functions, perform the operations as directed.

$$f(X) = 2X + 1 \qquad g(X) = 3X^2$$

- 1) Find the sum of the two functions.
- 2) Find the difference of the two functions. (Subtract the second from the first.)
- 3) Find the product of the two functions.
- 4) Find the quotient of the two functions. (Divide the first by the second.)
- 5) Find the function of a function. $f(g(X)) =$

Given the following functions, perform the operations as directed.

$$f(X) = 3X + 2 \qquad g(X) = X^2$$

- 6) Find the sum of the two functions.
- 7) Find the difference of the two functions. (Subtract the first from the second.)
- 8) Find the product of the two functions.
- 9) Find the quotient of the two functions. (Divide the second by the first.)
- 10) Find the function of a function. $g(f(X)) =$

Follow the directions.

- 11) Given $f(X) = 6X$ and $g(X) = 4X + 5$, find $f(X) + g(X)$.
- 12) Given $f(X) = X + 3$ and $g(X) = X^2 + 3$, find $f \cdot g(X)$.

Given the following functions, perform the operations as directed.

$$f(x) = x - 6$$

$$g(x) = x^2$$

- 1) Find the sum of the two functions.
- 2) Find the difference of the two functions. (Subtract the second from the first.)
- 3) Find the product of the two functions.
- 4) Find the quotient of the two functions. (Divide the first by the second.)
- 5) Find the function of a function. $f(g(x)) =$

Given the following functions, perform the operations as directed.

$$f(x) = 2x$$

$$g(x) = x^2 + 2$$

- 6) Find the sum of the two functions.
- 7) Find the difference of the two functions. (Subtract the first from the second.)
- 8) Find the product of the two functions.
- 9) Find the quotient of the two functions. (Divide the second by the first.)
- 10) Find the function of a function. $g(f(x)) =$

Follow the directions.

- 11) Given $f(x) = x - 1$ and $g(x) = x + 1$, find $f(x) \cdot g(x)$.
- 12) Given $f(x) = x^2 + 4x + 4$ and $g(x) = x + 2$, find $f \circ g(x)$.

- 1) $|X| = 6$
 $X = \pm 6$
- 2) $|X+4| = 7$
 $X+4 = 7$ $X+4 = 7$
 $X = 3$ $X = 11$
- 3) $|X - 8| = 3$
 $X - 8 = 3$ $X - 8 = 3$
 $X = 11$ $X = 5$
- 4) $|X+9| = 4$ No solutions
- 5) No solutions
- 6) $|X+2 - 3| = 2$
 $X+2 - 3 = 2$ $X+2 - 3 = 2$
 $X - 1 = 2$ $X - 1 = 2$
 $X = 3$ $X = 1$
- 7) $\sqrt{X} = 3$ Check:
 $X = 3^2$ $\sqrt{(9)} = 3$
 $X = 9$ $3 = 3$
- 8) $\sqrt[3]{X} = 2$ Check:
 $X = 2^3$ $\sqrt[3]{(8)} = 2$
 $X = 8$ $2 = 2$
- 9) $\sqrt{X+3} = 4$ Check:
 $X+3 = 4^2$ $\sqrt{(13)+3} = 4$
 $X+3 = 16$ $\sqrt{16} = 4$
 $X = 13$ $4 = 4$
- 10) $\sqrt{X+4} - 3 = 6$ Check:
 $\sqrt{X+4} = 9$ $\sqrt{77+4} - 3 = 6$
 $X+4 = 9^2$ $\sqrt{81} - 3 = 6$
 $X+4 = 81$ $9 - 3 = 6$
 $X = 77$ $6 = 6$
- 11) $\sqrt{X-2} + 7 = 11$ Check:
 $\sqrt{X-2} = 4$ $\sqrt{(18)-2} + 7 = 11$
 $X-2 = 4^2$ $\sqrt{16} + 7 = 11$
 $X-2 = 16$ $4 + 7 = 11$
 $X = 18$ $11 = 11$
- 12) $\sqrt[3]{(X)+2} + 4 = 7$ Check:
 $\sqrt[3]{X+2} = 3$ $\sqrt[3]{(25)+2} + 4 = 7$
 $X+2 = 3^3$ $\sqrt[3]{27} + 4 = 7$
 $X+2 = 27$ $3 + 4 = 7$
 $X = 25$ $7 = 7$
- 13) $\sqrt[4]{2X+8} - 1 = 1$ Check:
 $\sqrt[4]{2X+8} = 2$ $\sqrt[4]{2(4)+8} - 1 = 1$
 $2X+8 = 2^4$ $\sqrt[4]{16} - 1 = 1$
 $2X+8 = 16$ $2 - 1 = 1$
 $2X = 8$ $1 = 1$
 $X = 4$
- 14) $\sqrt[3]{X+2} = 9 - 8$ Check:
 $\sqrt[3]{X+2} = 1$ $\sqrt[3]{(1)+2} = 9 - 8$
 $X+2 = 1^3$ $\sqrt[3]{1} = 1$
 $X+2 = 1$ $1 = 1$
 $X = -1$
- 15) $\sqrt{2X-4} = \sqrt{X}$
 $\sqrt{2X-4} = 4 - \sqrt{X}$
 $2X-4 = (4 - \sqrt{X})(4 - \sqrt{X})$
 $2X-4 = 16 - 4\sqrt{X} - 4\sqrt{X} + X$
 $2X-4 = 16 - 8\sqrt{X} + X$
 $X-12 = 8\sqrt{X}$
 $(X-12)^2 = (8\sqrt{X})^2$
 $X^2 - 24X + 144 = 64X$
 $X^2 - 40X + 144 = 0$
 $(X-4)(X-36) = 0$
 $X-4 = 0$ $X-36 = 0$
 $X = 4$ $X = 36$
- Check: Check:
 $\sqrt{2(4)-4} = \sqrt{(4)}$ $\sqrt{2(36)-4} = \sqrt{(36)}$
 $\sqrt{8-4} = 2$ $\sqrt{72-4} = 6$
 $\sqrt{4} = 2$ $\sqrt{68} = 6$
 $2 = 2$ $\sqrt{68} = 2$

- 1) $|X|=8$
 $X = \pm 8$
- 2) $|X+9|=2$
 $X+9=2$ $X+9=2$
 $X=7$ $X=11$
- 3) $|X-5|=6$ No solutions
- 4) $|X+1|=9$
 $X+1=9$ $X+1=9$
 $X=8$ $X=10$
- 5) $|X+3+4|=5$
 $X+3+4=5$ $X+3+4=5$
 $X+7=5$ $X+7=5$
 $X=2$ $X=12$
- 6) $|X-8+2|=16$
 $X-8+2=16$ $X-8+2=16$
 $X-6=16$ $X-6=16$
 $X=22$ $X=10$
- 7) $\sqrt{X}=4$ Check:
 $X=4^2$ $\sqrt{(16)}=4$
 $X=16$ $4=4$
- 8) $\sqrt[3]{X}=1$ Check:
 $X=1^3$ $\sqrt[3]{(1)}=1$
 $X=1$ $1=1$
- 9) $\sqrt{X+2}=3$ Check:
 $X+2=3^2$ $\sqrt{(7)}+2=3$
 $X+2=9$ $\sqrt{9}=3$
 $X=7$ $3=3$
- 10) $\sqrt{X-1}+5=10$ Check:
 $\sqrt{X-1}=5$ $\sqrt{(26)}-1+5=10$
 $X-1=5^2$ $\sqrt{25}+5=10$
 $X-1=25$ $5+5=10$
 $X=26$ $10=10$
- 11) $\sqrt{X+4}-3=1$ Check:
 $\sqrt{X+4}=4$ $\sqrt{(12)+4}-3=1$
 $X+4=4^2$ $\sqrt{16}-3=1$
 $X+4=16$ $4-3=1$
 $X=12$ $1=1$
- 12) $\sqrt[3]{X-2}-9=7$ Check:
 $\sqrt[3]{X-2}=2$ $\sqrt[3]{(10)}-2-9=7$
 $X-2=2^3$ $\sqrt[3]{8}-9=7$
 $X-2=8$ $2-9=7$
 $X=10$ $7=7$
- 13) $\sqrt[4]{2X+1}+11=14$ Check:
 $\sqrt[4]{2X+1}=3$ $\sqrt[4]{2(40)+1}+11=14$
 $2X+1=3^4$ $\sqrt[4]{81}+11=14$
 $2X+1=81$ $3+11=14$
 $2X=80$ $14=14$
 $X=40$
- 14) $\sqrt[3]{X+1}+8=5+20$ Check:
 $\sqrt[3]{X+1}=7$ $\sqrt[3]{(342)+1}+8=5+20$
 $X+1=7^3$ $\sqrt[3]{343}+8=15$
 $X+1=343$ $7+8=15$
 $X=342$ $15=15$
- 15) $\sqrt{2X-2}-1=\sqrt{3X}$
 $\sqrt{2X-2}=1+\sqrt{3X}$
 $2X-2=1+2\sqrt{3X}+3X$
 $X-3=2\sqrt{3X}$
 $(X-3)^2=(2\sqrt{3X})^2$
 $X^2+6X+9=12X$
 $X^2-6X+9=0$
 $(X-3)(X-3)=0$
 $X=3$
- Check:
 $\sqrt{2(3)-2}-1=\sqrt{3(3)}$
 $\sqrt{4}-1=\sqrt{9}$
 $2-1=3$
 $1=3$
- No real solution

1) $|X - 3| = 3$

$X - 3 = 3$ $X - 3 = -3$

$X = 6$ $X = 0$

2) See graph

3) $|(-1) - 3| = 3$

$4 - 3 = 1$ Yes

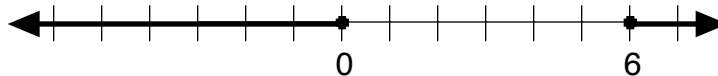
1 - 4

$|1 - 3| = 3$

$2 - 3 = -1$ No

$|7 - 3| = 3$

$4 - 3 = 1$ Yes



4) See graph

5) $|4X + 9| + 1 = 4$

$4X + 9 = 3$ $4X + 9 = 3$

$4X = -6$ $4X = -12$

$X = -1\frac{1}{2}$ $X = -3$

6) See graph

7) $|4(-4) + 9| + 1 > 4$

$7 + 1 > 4$

$8 > 4$ Yes

5 - 8

$|4(-2) + 9| + 1 > 4$

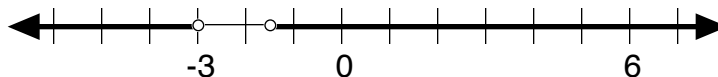
$1 + 1 > 4$

$2 > 4$ No

$|4(0) + 9| + 1 > 4$

$9 + 1 > 4$

$10 > 4$ Yes



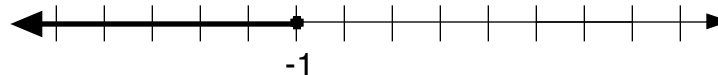
8) See graph

9) $\sqrt{X + 5} = 2$

$X + 5 = 4$

$X = -1$

#10



10) See graph

11) $\sqrt{(-2) + 5} = 2$

$\sqrt{3} = 2$

1.7 = 2 Yes

$\sqrt{(4) + 5} = 2$

$\sqrt{9} = 2$

3 = 2 No

12) Some

13) $|x - 2| = 0$ All: Absolute value is always positive14) $|3X + 8| < 4$ None: Absolute value is never negative

$$1) |X+4| = 3$$

$$X+4 = 3 \quad X+4 = 3$$

$$X = 1 \quad X = 7$$

2) See graph

$$3) |(2)+4| = 3$$

$$2 + 3 \text{ Yes}$$

$$|(8)+4| = 3$$

$$4 + 3 \text{ No}$$

$$|(1)+4| = 3$$

$$5 + 3 \text{ No}$$

4) See graph

$$5) |2X - 1| = 1$$

$$2X - 1 = 1 \quad 2X - 1 = -1$$

$$2X = 2 \quad 2X = 0$$

$$X = 1 \quad X = 0$$

6) See graph

$$7) |2(-1) - 1| > 1$$

$$3 > 1 \text{ Yes}$$

$$\left| 2 \left(\frac{1}{2} \right) - 1 \right| > 1$$

$$|1 - 1| > 1$$

$$0 > 1 \text{ No}$$

$$|2(2) - 1| > 1$$

$$4 - 1 > 1$$

$$3 > 1 \text{ Yes}$$

8) See graph

$$9) \sqrt{X+12} = 4$$

$$X+12 = 16$$

$$X = 4$$

10) See graph

$$11) \sqrt{(0)+12} = 4$$

$$12 = 16 \text{ No}$$

$$\sqrt{(5)+12} = 4$$

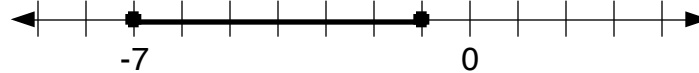
$$17 = 16 \text{ Yes}$$

12) $|2X - 5| < 3$ None: Absolute value is never negative

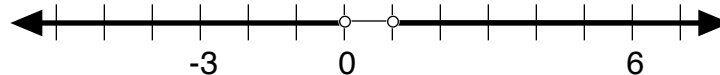
13) Some

14) $|6X - 16| = 0$ All: Absolute value is always positive

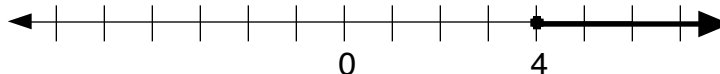
#1 - #4



#5 - #8



#10



- 1) yes
- 2) (,)
- 3) (,)
- 4) yes
- 5) (,)
- 6) (2,)
- 7) no
- 8) NA
- 9) NA
- 10) yes
- 11) $X \neq 0$
- 12) $f(X) = 0$
- 13) $f(X) = 6X - 1$
 $= 6(3) - 1$
 $= 18 - 1$
 $= 17$
- 14) $f(X) = X^2 + 5$
 $= (3)^2 + 5$
 $= 9 + 5$
 $= 14$
- 15) $f(X) = 6X - 1$
 $= 6(20) - 1$
 $= 120 - 1$
 $= 119$
- 16) $f(X) = X^2 + 5$
 $= (20)^2 + 5$
 $= 400 + 5$
 $= 405$
- 1) yes
- 2) (,)
- 3) 4
- 4) no
- 5) NA
- 6) NA
- 7) yes
- 8) (,)
- 9) [0,)
- 10) no
- 11) NA
- 12) NA
- 13) $f(X) = X + 1$
 $= (0) + 1$
 $= 1$
- 14) $f(X) = 2X^2 + 8$
 $= 2(0)^2 + 8$
 $= 8$
- 15) $f(X) = X + 1$
 $= (5)^2 + 1$
 $= 6 + 1$
 $= 7$
- 16) $f(X) = 2X^2 + 8$
 $= 2(5)^2 + 8$
 $= 50 + 8$
 $= 58$

- 1) $2X+1+3X^2 = 3X^2+2X+1$
 - 2) $2X+1-3X^2 = 3X^2+2X+1$
 - 3) $(2X+1)(3X^2) = 6X^3+3X^2$
 - 4) $\frac{2X+1}{3X^2}$
 - 5) $2(3X^2)+1 = 6X^2+1$
 - 6) X^2+3X+2
 - 7) $X^2-(3X+2) = X^2-3X-2$
 - 8) $X^2(3X+2) = 3X^3+2X^2$
 - 9) $\frac{X^2}{3X+2}$
 - 10) $(3X+2)^2 = 9X^2+12X+4$
 - 11) $6X+4X+5 = 10X+5$
 - 12) $(X^2+3)(X+3) = X^3+3X^2+3X+9$
- 1) $(X-6)+X^2 = X^2+X-6$
 - 2) $(X-6)-X^2 = X^2+X-6$
 - 3) $X^2(X-6) = X^3-6X^2$
 - 4) $\frac{X-6}{X^2}$
 - 5) $(X^2)-6 = X^2-6$
 - 6) X^2+2X+2
 - 7) $(X^2+2)-2X = X^2-2X+2$
 - 8) $2X(X^2+2) = 2X^3+4X$
 - 9) $\frac{X^2+2}{2X}$
 - 10) $(2X)^2+2 = 4X^2+2$
 - 11) $(X-1)(X+1) = X^2-1 = X^2-1-2$
 - 12) $\frac{X^2+4X+4}{X+2} = \frac{(X+2)\cancel{(X+2)}}{\cancel{(X+2)}} = X+2$