Lesson 1.4 Objective: SWBAT determine the domain and range of a function graphically.

Kickoff

On the post it on your desk (put your name on it), evaluate the difference quotient with $f(x) = x^2 - 5x$

$\frac{f(x+h)-f(x)}{h}$ $f(x+h)=(x+h)^2-5(x+h)$

$\frac{[(x+h)^2-5(x+h)]-[x^2-5x]}{h}$

$(x+h)(x+h)-5x-5h-x^2+5x$

$x^2+xh+hx+h^2-5x-5h-x^2+5x$

$\frac{2hx+h^2-5h}{h}=2x+h-5$

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80) $\frac{[3(x+h)-1]-[3x-1]}{h}$

$\frac{3x+3h-1-3x+1}{h}=\frac{3h}{h}=3$

82) $\frac{f(5+h)-f(5)}{h}$ $\frac{[5(5+h)-(5+h)^2]-[5(5)-5^2]}{h}$

$\frac{[25+5h-(5+h)(5+h)]}{h}$

$25+5h-(25+10h+h^2)$

$25+5h-25-10h-h^2$

$\frac{-5h-h^2}{h}=-5-h$

$\frac{f(x+h)-f(x)}{h}$ More practice

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

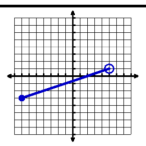
$\frac{[(x+h)^2+2]-[x^2+2]}{h}$

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

EXAMPLES OF DOMAINS AND RANGES FROM GRAPHS

Important notes about Domains and Ranges from Graphs:

- Remember that **domain** refers to the x-values that are represented in a problem and **range** refers to the y-values that are represented in a problem.
- Sometimes it isn't possible to list all the values that x or y can be because the graph is **continuous** and made up of an infinite number of points, like a line, a ray, or even a segment.
- In a continuous graph, to determine the **domain**, you should focus on looking **left to right of the graph**.
- In a continuous graph, to determine the **range**, you should focus on looking **bottom to top of the graph**.
- We use **interval notation** to help us describe the domain and range for graphs that represent continuous situations.
- Please review the following information to help you describe the domain and range for three different types of continuous graphs.

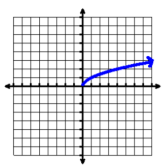


Important Note:
- To find the domain for a graph with two endpoints, always identify the x-values of the point farthest to the left and the point farthest to the right.
- For the range, you want the y-values of the lowest point and the highest point.

Domain: {-7 ≤ x < 5}
- Notice that this graph has two endpoints, so the graph starts and stops and the **domain covers all x-values between the two endpoints** which makes it a continuous graph.
- Since the left and right endpoints are at (-7, -3) and (5, 1), the graph covers all **x-values between the x-values of -7 and -3.**
- Notice that the first endpoint is a closed circle so it includes that point; but the second endpoint is an open circle, so it does not include that point.
- Therefore, the graph covers **all x-values ≥ -7 AND all x-values < 5** – we write that in interval notation as {-7 ≤ x < 5}

Range: {-3 ≤ y < 1}
- Notice that this graph has two endpoints, so the graph starts and stops and the **range covers all y-values between the two endpoints** which makes it a continuous graph.
- Since the bottom and top endpoints are at (-7, -3) and (5, 1), the graph covers all **y-values between the y-values of -3 and 1.**
- Notice that the first endpoint is a closed circle so it includes that point; but the second endpoint is an open circle, so it does not include that point.
- Therefore, the graph covers **all y-values ≥ -3 AND all y-values < 1** – we write that in interval notation as {-3 ≤ y < 1}

Example 2 – a continuous graph with only one endpoint (so continues forever in the other direction)

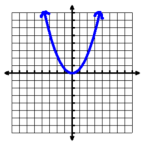


Note: If the arrow were pointing to the left, the domain would be ≤ the x-value. If the arrow were pointing down, the range would ≤ the y-value.

Domain: {x ≥ 0} (remember to focus on left to right of the graph for domain of a continuous graph):
- Notice that this graph has one endpoint at (0, 0) and an arrow to the right indicating that it continues forever in the positive x direction.
- Therefore, this graph covers all x-values that are greater than or equal to 0 – there is no stopping point on the right side of the graph.
- We write the domain in interval notation as {x ≥ 0}.

Range: {y ≥ 0} (remember to focus on bottom to top of the graph for range of a continuous graph):
- Notice that this graph has one endpoint at (0, 0) and an arrow pointing up indicating that it continues forever in the positive y direction.
- Therefore, this graph covers all y-values that are greater than or equal to 0 – there is no stopping point on the upper side of the graph.
- We write the range in interval notation as {y ≥ 0}.

Example 3 – a continuous graph that has two arrows:



Note: If one of the arrows were pointing up and one of the arrows were pointing down, then the range would be all real numbers.

Domain: {x = all real numbers} (remember to focus on left to right of the graph to determine the domain for a continuous graph)

- Notice that this graph has an **arrow on the left side** of the graph and an **arrow on the right side** of the graph.
- This indicates that the graph **continues forever in the left direction and forever in the right direction**.
- This means that the graph covers **all possible x-values** – we call that all real numbers in algebra.
- Therefore, we can write the domain in interval notation as: {x = all real numbers}.

Range: {y ≥ 0} (remember to focus on bottom to top of the graph to determine the range of a continuous graph)

- Notice that the **graph's lowest point is at (0, 0)** (the bottom of the parabola) – indicating that the y-values start at 0.
- However, notice at the **top of the graph there are arrows pointing up** – this indicates the graph continues in the positive y direction forever.
- So, the graph covers **all y-values greater than or equal to 0.**
- We can write the range in interval notation as: {y ≥ 0}.

_____ 1. Domain: {-4 ≤ x ≤ 4} Range: {-4 ≤ y ≤ 4} Function: NO	_____ 2. Domain: {-3 < x ≤ 5} Range: {y = -1} Function: YES	_____ 3. Domain: {-4 ≤ x ≤ 2} Range: {-2 ≤ y ≤ 4} Function: YES
_____ 4. Domain: {x > 0} Range: {y = 4} Function: YES	_____ 5. Domain: {-6 ≤ x ≤ 6} Range: {0 ≤ y ≤ 6} Function: YES	_____ 6. Domain: {x = -5} Range: {-2 < y < 6} Function: NO

_____ 7. Domain: {x ≥ 0} Range: {all real numbers} Function: NO	_____ 8. Domain: {-3 ≤ x ≤ 4} Range: {-2 ≤ y ≤ 4} Function: NO	_____ 9. Domain: {all real numbers} Range: {all real numbers} Function: YES
_____ 10. Domain: {-7 ≤ x < 5} Range: {-3 ≤ y < 1} Function: YES	_____ 11. Domain: {all real numbers} Range: {y ≥ 0} Function: YES	_____ 12. Domain: {-3 < x < 4} Range: {0 ≤ y ≤ 5} Function: YES

_____ 13. Domain: {-6 ≤ x ≤ 3} Range: {-6 ≤ y ≤ -1} Function: YES	_____ 14. Domain: {0 ≤ x < 5} Range: {0 ≤ y < 7} Function: YES	_____ 15. Domain: {-5 ≤ x < 0} Range: {-5 < y ≤ -1} Function: YES
_____ 16. Domain: {-6 ≤ x ≤ 3} Range: {-5 ≤ y ≤ -1} Function: YES	_____ 17. Domain: {0 ≤ x ≤ 6} Range: {0 ≤ y ≤ 7} Function: YES	_____ 18. Domain: {-4 ≤ x ≤ 7} Range: {-7 ≤ y ≤ -2} Function: NO

_____ 19. Domain: {x ≤ 0} Range: {y ≥ 0} Function: YES	_____ 20. Domain: {2 ≤ x ≤ 7} Range: {1 ≤ x ≤ 6} Function: NO	_____21. Domain: {0 ≤ x ≤ 4} Range: {0 ≤ y ≤ 6} Function: YES
_____ 22. Domain: {-4 < x < 5} Range: {-2 ≤ y < 5} Function: YES	_____ 23. Domain: {x ≤ 5} Range: {y = 0} Function: YES	_____ 24. Domain: {-7 < x < 0} Range: {-3 < y < 4} Function: YES