

Domain and Range of a Function

Name: _____ Date: _____ Score: _____ / 24

Q Quick Review

The **domain** of a function is the set of allowable inputs; the **range** is the set of outputs the function actually reaches. Together they describe the function's "window of operation."

Three common domain restrictions. (1) The denominator can't be zero — so for $h(x) = \frac{1}{x-3}$, exclude $x = 3$. (2) An even-index radical's radicand can't be negative — so $\sqrt{x-4}$ requires $x \geq 4$. (3) A logarithm's argument must be positive (covered in Chapter 9). Real-world context can also restrict the domain (no negative time, no fractional people, etc.).

Combining restrictions. If a function has two restrictions, intersect them. $f(x) = \frac{\sqrt{x}}{x-5}$ needs $x \geq 0$ (radical) and $x \neq 5$ (denominator). Domain: $[0, 5) \cup (5, \infty)$.

Range tactics. For $f(x) = x^2 + 1$: $x^2 \geq 0$, so the smallest output is 1. Range $[1, \infty)$. For $g(x) = -|x-2| + 3$: $|x-2| \geq 0$, so $-|x-2| \leq 0$ and $-|x-2| + 3 \leq 3$. Range $(-\infty, 3]$. The general move: find the extreme values the function can produce.

From a graph. The domain is the set of x -values the graph covers (its projection on the x -axis); the range is the set of y -values it covers (its projection on the y -axis). Closed dots mean the endpoint is included; open dots mean it's excluded.

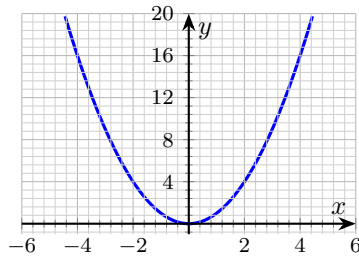
PRACTICE

Find the domain and/or range as requested.

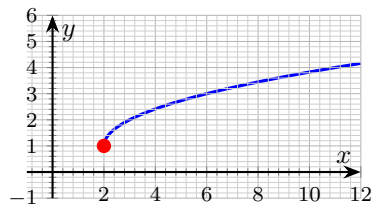
1. Domain of $f(x) = x^2 - 3x + 5$ _____
2. Domain of $g(x) = \sqrt{x-4}$ _____
3. Domain of $h(x) = \frac{1}{x-3}$ _____
4. Range of $f(x) = x^2 + 1$ _____
5. Domain of $\frac{\sqrt{x}}{x-5}$ _____
6. Range of $g(x) = -|x-2| + 3$ _____
7. Domain of $f(x) = \sqrt{9 - (x-2)^2}$ _____
8. Domain of $p(x) = \frac{\sqrt{x+1}}{x-4}$ _____
9. Domain of $q(x) = -2\sqrt{x-3} + 5$ _____
10. Range of $f(x) = \frac{1}{x^2 + 1}$ _____
11. Domain of $f(x) = \sqrt{4 - x^2}$ _____
12. Domain of $f(x) = \frac{x+1}{x^2 - 4}$ _____



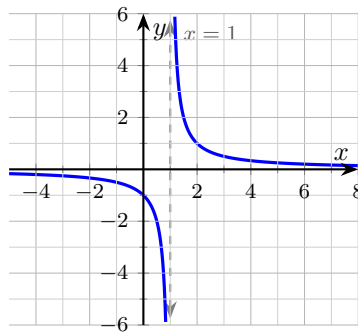
13. $f(x) = x^2$ graphed below; read its domain and range from the picture. _____



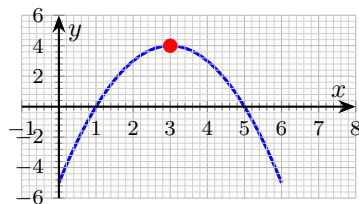
14. From the graph of $f(x) = \sqrt{x-2} + 1$ below, find the domain. _____



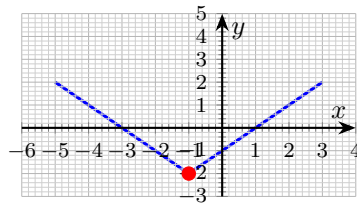
15. From the graph of $f(x) = \frac{1}{x-1}$ below, find the domain. _____



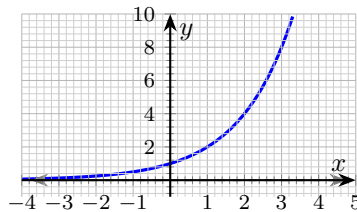
16. From the graph of $f(x) = -(x-3)^2 + 4$ below, find the range. _____



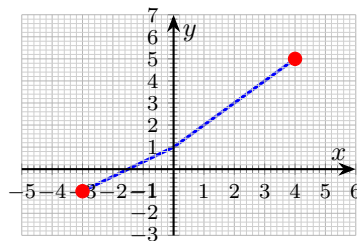
17. From the graph of $f(x) = |x + 1| - 2$ below, find the range. _____



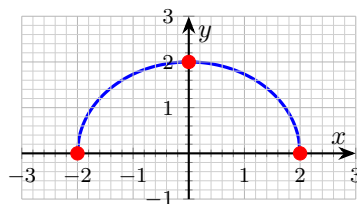
18. From the graph of $f(x) = 2^x$ below, find the range. _____



19. Graph below shows a continuous curve from $(-3, -1)$ to $(4, 5)$. Domain? _____

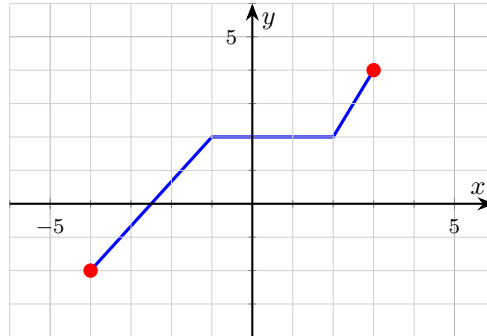


20. From the graph of $f(x) = \sqrt{4 - x^2}$ (upper semicircle) below, find the range. _____

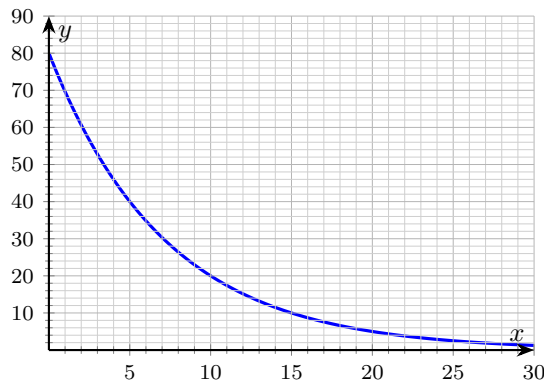


◆ Word Problems

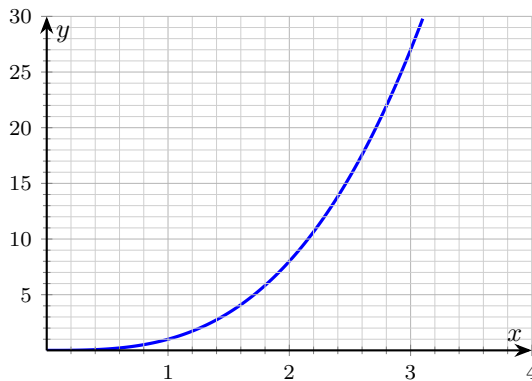
21. From the graph below, state the domain and range of $y = p(x)$. _____



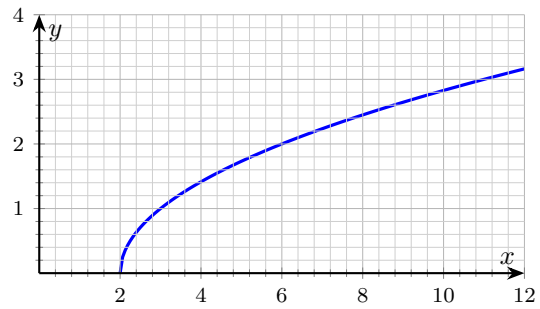
22. A radioactive sample's mass follows $m(t) = 80 \cdot 2^{-t/5}$ grams for $t \geq 0$ hours. State the domain and range, and explain in plain English. _____



23. A box's volume as a function of side length x is $V(x) = x^3$ for $x > 0$. State the domain and range in the real-world context, then sketch the function for $0 \leq x \leq 3$. _____



24. A spring's stretch length is $L(F) = \sqrt{F - 2}$ centimeters when force F (in newtons) is applied, valid for $F \geq 2$. Find the domain and range. _____



Answer Keys

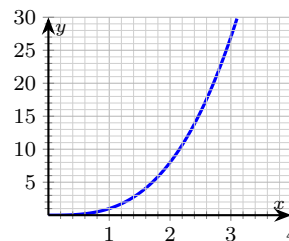
- | | |
|--|--|
| <p>1. \mathbb{R}</p> <p>2. $[4, \infty)$</p> <p>3. $\{x : x \neq 3\}$</p> <p>4. $[1, \infty)$</p> <p>5. $[0, 5) \cup (5, \infty)$</p> <p>6. $(-\infty, 3]$</p> <p>7. $[-1, 5]$</p> <p>8. $[-1, 4) \cup (4, \infty)$</p> <p>9. $[3, \infty)$</p> <p>10. $(0, 1]$</p> <p>11. $[-2, 2]$</p> <p>12. $\{x : x \neq \pm 2\}$</p> | <p>13. domain \mathbb{R}, range $[0, \infty)$</p> <p>14. $x \geq 2$</p> <p>15. $\{x : x \neq 1\}$</p> <p>16. $(-\infty, 4]$</p> <p>17. $[-2, \infty)$</p> <p>18. $(0, \infty)$</p> <p>19. $[-3, 4]$</p> <p>20. $[0, 2]$</p> <p>21. domain $[-4, 3]$, range $[-2, 4]$</p> <p>22. domain $[0, \infty)$, range $(0, 80]$</p> <p>23. domain $(0, \infty)$, range $(0, \infty)$</p> <p>24. domain $[2, \infty)$, range $[0, \infty)$</p> |
|--|--|

Step-by-Step Explanations

1. A careful way to see it: Polynomials are defined for every real input. This is the part to check before moving on, because it keeps the answer tied to the original question.
2. Keep the rule visible: Radicand ≥ 0 : $x - 4 \geq 0$, so $x \geq 4$. This is the part to check before moving on, because it keeps the answer tied to the original question.
3. One steady path is: Denominator zero at $x = 3$. This is the part to check before moving on, because it keeps the answer tied to the original question.
4. Start with the key idea: $x^2 \geq 0 \Rightarrow x^2 + 1 \geq 1$. Minimum is 1 at $x = 0$. This is the part to check before moving on, because it keeps the answer tied to the original question.
5. A careful way to see it: Two restrictions: $x \geq 0$ and $x \neq 5$. Combine. This is the part to check before moving on, because it keeps the answer tied to the original question.
6. Keep the rule visible: $-|x - 2| \leq 0$, so $-|x - 2| + 3 \leq 3$. Max is 3 at $x = 2$. This is the part to check before moving on, because it keeps the answer tied to the original question.
7. One steady path is: $9 - (x - 2)^2 \geq 0 \Rightarrow (x - 2)^2 \leq 9 \Rightarrow |x - 2| \leq 3 \Rightarrow -1 \leq x \leq 5$. This is the part to check before moving on, because it keeps the answer tied to the original question.
8. Start with the key idea: Need $x + 1 \geq 0$ AND $x \neq 4$. This is the part to check before moving on, because it keeps the answer tied to the original question.
9. A careful way to see it: Radicand ≥ 0 : $x \geq 3$. This is the part to check before moving on, because it keeps the answer tied to the original question.
10. Keep the rule visible: $x^2 + 1 \geq 1$, so $\frac{1}{x^2 + 1} \leq 1$. Always positive, so > 0 . Max 1 at $x = 0$; approaches 0 as $|x| \rightarrow \infty$. That gives a quick check on the answer.
11. One steady path is: $4 - x^2 \geq 0 \Rightarrow x^2 \leq 4 \Rightarrow |x| \leq 2$. This is the part to check before moving on, because it keeps the answer tied to the original question.
12. Start with the key idea: $x^2 - 4 = 0$ at $x = \pm 2$. Exclude both. This is the part to check before moving on, because it keeps the answer tied to the original question.
13. The graph fills the entire x -axis (no gaps), so domain is all reals. Its lowest output is 0 at the origin; it goes up forever. Range $[0, \infty)$.
14. Keep the rule visible: The curve starts at $(2, 1)$ with a filled dot and extends right. So $x \geq 2$. That gives a quick check on the answer.
15. Vertical asymptote at $x = 1$ (gray dashed line). Function is defined everywhere else.
16. Maximum value is at the vertex $(3, 4)$. Parabola opens downward, so all values ≤ 4 are achieved.

17. A careful way to see it: V-shape with vertex at $(-1, -2)$, opens up. Minimum is -2 ; no upper bound. That gives a quick check on the answer.
18. Exponential always positive; approaches 0 from above (gray dashed asymptote $y = 0$) and grows without bound to the right.
19. Filled endpoints at $x = -3$ and $x = 4$, so both are included. Domain is the closed interval $[-3, 4]$.
20. Semicircle radius 2, centered at origin, upper half only. Output between 0 and 2 inclusive.
21. The piecewise polyline runs from $x = -4$ (filled left endpoint) to $x = 3$ (filled right endpoint), so the domain is $[-4, 3]$. The y -values covered run from a low of -2 (at $x = -4$) up to 4 (at $x = 3$), and every value between gets hit somewhere along the line. Range $[-2, 4]$.
22. Time runs from 0 forward, so domain is $[0, \infty)$. At $t = 0$, $m(0) = 80$. As t grows, $m(t)$ decays toward 0 but never reaches it (horizontal asymptote $y = 0$). So range is $(0, 80]$. The mass starts at 80 grams and halves every 5 hours — after 30 hours, only about 1.25 grams remain.
23. Side length must be positive (a box with side 0 has no volume; negative side has no physical meaning), so domain is $(0, \infty)$. The cube function grows without bound and is always positive on this domain, so range is $(0, \infty)$. The graph rises slowly at first and then quickly — doubling the side *eight times* the volume.

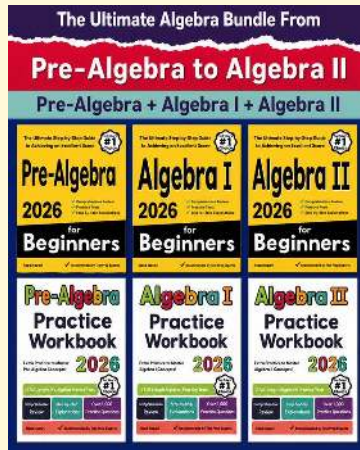
Answer graph



24. The radicand $F - 2$ must be ≥ 0 , so $F \geq 2$. Below 2 newtons the model doesn't apply — presumably the spring resists with static friction below that threshold. The output $\sqrt{F - 2}$ is ≥ 0 and increases without bound, so range is $[0, \infty)$. The curve starts at $(2, 0)$ and rises slowly — the square root flattens out as F grows.



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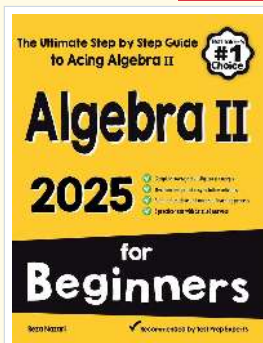
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