| Transforming and Analyzing Absolute Value Functions | |
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| Abso | lute | Va | lue |
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| Funct | ions | 5 | |

- For an Absolute Value Value function, the general form is f(x) = a|bx-c|+d, where a,b,c, and d are real numbers.
- The Absolute Value parent function is f(x) = |x|
- The full family of Absolute Value functions is generated by applying transformations to the Absolute Value parent function
- Transformations are applied using parameters that are multiplied or added to the independent variable in the functional relationship

Changes in α

- \bullet The parameter a influences the vertical stretch or compression of the graph.
- If |a| > 1, then the y-values are multiplied by a factor of a to vertically stretch the graph
- If o < |a| < 1, then the y-values are multiplied by a factor of a to vertically compress the graph

| | The parameter b influences the horizontal stretch or compression |
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| | of the graph. |
| | If b > 1, then the x-values are multiplied by a factor of 1 to horizontally compress the graph |
| Changes in b | • If $o < b < 1$, then the x-values are multiplied by a factor of $\frac{1}{ b }$ to |
| | horizontally stretch the graph |
| | • If b < o, then the graph will be reflected across the y-axis |
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| | ullet The parameter c , like b , influences the horizontal translation of the |
| | graph. |
| | Note that in the general form, the sign in front of the c is negative. This means that when reading the value of c from the equation, you should read the opposite sign from what is given in the |
| Changes in c | you should read the opposite sign from what is given in the equation. |
| <i>J</i> | • If $c > 0$, then the graph will translate $\left \frac{c}{b} \right $ to the right. |
| | • If $c < 0$, then the graph will translate $ \frac{c}{h} $ to the left. |
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| | The parameter d influences the vertical translation of the graph. If d > 0, then the graph will translate d units up. |
| Changes in d | If d > 0, then the graph will translate d units up. If d < 0, then the graph will translate d units down. |
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| Vertex | • The vertex of an absolute value graph is a maximum or minimum value. If the graph opens up, then the vertex is a minimum value. If the graph opens down, then the vertex is a maximum value. • The location of the vertex is $\cdot \cdot \binom{c}{b}, d)$ | |
| | | |
| Domain and Range | A Absolute Value function involves squaring a number. Since every real number can be squared, there are no domain restrictions. Therefore, the domain will always be all real numbers, or {x x ∈ ℝ} The range does have restrictions. The range is affected by parameters a and d. If a > 0, then d sets the y-coordinate of the vertex at a minimum value. The range becomes y ≥ d or {f(x) f(x) ≥ d} If a < 0, then d sets the y-coordinate of the vertex at a maximum value. The range becomes y ≤ d or {f(x) f(x) ≤ d} | |
| | |] |
| X- and Y- intercepts | • A Absolute Value function has as many as two x-intercepts, also called zeroes. The x-intercepts are located at: $\cdot \left(\frac{c+\frac{d}{b}}{b}, 0\right)$ • If the is in the general form $y = a bx-c +d$ then we find the y-intercept by substituting $x = 0$: • the y-intercept becomes $(0, a c +d)$ | |

| Examples ** One of the water of the absolute value promotion of the absolute value promotion of the absolute value broades and the special of the absolute value broades and the value of the promotion of the absolute value broades and the value of the promotion of the absolute value broades and the value of the promotion of the absolute value val | | | _ |
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| Examples - Stap a. Rewrite the equation of gluin general form to determine the violes of the perimenens a, b, c, and d, gloin - (x + y) - (x - y) | | _ | |
| Examples - Size 3. Dewrite the equation of glain general from to determine the values of the parameters a, 6, 4, and 6 - gla | | | |
| Examples - Size 3. Denote the equation of gid in general from to determine the values of the parameters a, b, c, and d, - gid - gid - 2 + 4 - gi | | | |
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| Examples - Size 3. Denote the equation of gid in general from to determine the values of the parameters a, b, c, and d, - gid - gid - 2 + 4 - gi | | What transformations of the absolute value parent function, f(x) = | |
| Examples - Size 3. Denote the equation of gid in general from to determine the values of the parameters a, b, c, and d, - gid - gid - 2 + 4 - gi | Examples | x , will result in the graph of the absolute value function $g(x) = -\frac{1}{2} 2x + 1 - 3?$ | |
| Fixamples - g(x) = 3(x - x)^2 + 4 - (y(x) = \frac{1}{3}(x - 1)^2 + (4) - (y(x) = \frac{1}{3}(x - 1)^2 + (4 | | _ | |
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| Fxamples - g(x) = 3(x - x)^2 + d - g(x) = \frac{1}{3}(x - 1)^3 + (4) - g(x) = \frac{1}{3}(x - 1)^3 + (4) - So, a = \frac{1}{3}b = 1, c = 1, and d = -4 - Sup 2: Use the values of the parameters to describe the transformation of the Absolute Value parent forction f(x) that are necessary to produce g(x). - a = $\frac{1}{13}$ so [a] > 1, then the y-values are multiplied by a factor of $\frac{1}{3}$ to vertically compress the graph - b = 1, there is no affect to the graph - c = 1, so c < 0, then the graph will translate [1] = 1 to the right | | | |
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| Fixamples - g(x) = 3(x - x)^2 + 4 - (y(x) = \frac{1}{3}(x - 1)^2 + (4) - (y(x) = \frac{1}{3}(x - 1)^2 + (4 | | Step 1: Rewrite the equation of g(x) in general form to determine the values of the parameters a, b, c, and d. | |
| - \$\(\text{g} \) 2: Use the values of the parameters to describe the transformations of the Absolute Value parent function f(s) that are necessary to produce g(s). 1 = \frac{1}{3} \text{ so } a > 1, then the y-values are multiplied by a factor of \frac{1}{3} to vertically compress the graph 2 = 1, so < < 0, then the graph will translate 1 = 1 to the right | | • $g(x) = a(bx - c)^2 + d$ | |
| - \$\(\frac{1}{3}\times - | Examples | • $g(x) = \frac{1}{3}(x-1)^2 - 4$ | |
| - Step 2: Use the values of the parameters to describe the transformations of the Absolute Value parent function (f ₂) that are necessary to produce g(s). - a = \frac{1}{2} \times a b \times 1, then the y-values are multiplied by a factor of \frac{1}{3} to vertically compress the graph - b = 1; there is no affect to the graph - c = 1, so < c \times, the condition of | • | • $g(x) = \frac{1}{3}(x-1)^2 + (-4)$ | |
| enecessary to produce $g(x)$. • $a = \frac{1}{3}$, so $ a > 1$, then the y-values are multiplied by a factor of $\frac{1}{3}$ to vertically compress the graph • $b = 1$; there is no affect to the graph • $c = 1$, so $c < 0$, then the graph will translate $ 1 = 1$ to the right | | • So, a = $\frac{1}{3}$, b = 1, c = 1, and d = -4 | |
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| Examples • b = 1; there is no affect to the graph • c = 1, so c < 0, then the graph will translate 1 = 1 to the right | | | |
| • c = 1, so c < 0, then the graph will translate 1 = 1 to the right | | | |
| | Examples | | |
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| | • Identify the key attributes of f(x) = $\frac{5}{1}$ x + 2l - 1, including domain. | |
| Examples | Identify the key attributes of f(x) = ⁵/₄ x + 2 - 1, including domain, range, vertex, x- and y-intercepts. Write the domain and range as intervals and in set builder notation. Determine whether the | |
| | vertex is a maximum or a minimum value of the function. | _ |
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| | • Step 1: Determine the domain and range of f(x) = $\frac{5}{4}$ x + 2 - 1. The | |
| | domain is always all real numbers | - |
| | • (- ∞, ∞) • {x x∈ ℝ} | |
| E | | - |
| Examples | • Since a > 0, the graph will open up. So the range will be numbers $f(x) > -1$ | |
| | • (-1, ∞) • {f(x) f(x) ≥ -1) | |
| | · ((x) (x) = -1) | |
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| | Store Determine the surface felt | |
| | • Step 2: Determine the vertex of the graph. $ \cdot \ \text{The vertex is } (\frac{c}{c},d) $ | |
| Evamples | • $(\frac{-2}{1}, -1) = (-2, -1)$ | |
| Examples | • Since a > o, this value is a minimum | |
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| Examples | • Step 3: Determine the x-intercepts. $ \cdot \text{ The x-intercepts are located at} \left(\frac{c\pm\frac{d}{a}}{b}, o\right) \\ \cdot \left(\frac{-2\pm\frac{1}{1125}}{1}, o\right) \\ \cdot \left(\frac{-2\pm\frac{1}{5}}{1}, o\right) \\ \cdot \left(-2\pm\frac{4}{5}, o\right) \\ \cdot \left(-2\pm\frac{4}{5}, o\right) \\ \cdot \left(-2+\frac{4}{5}, o\right), \left(-2-\frac{4}{5}, $ | | | |
|----------|---|-------------|--|--|
| | | _ | | |
| | • Step 4: Determine the y-intercepts | _ | | |
| Examples | • The y-intercept occurs where $x = 0$ • $f(x) = \frac{5}{4} x + 2 - 1$ • $f(x) = \frac{5}{4} 0 + 2 - 1$ • $f(x) = \frac{5}{4} 0 - 1$ • $f(x) = \frac{10}{4} - 1$ • $f(x) = \frac{10}{4} - 1$ • $f(x) = \frac{6}{4} = 1.5$ • $(0, 1.5)$ | - - - | | |
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