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1. 2 parent functions and transformations answers

This section covers: (For Absolute Value Conversions, see Absolute Value Conversions.) Before you begin, here are links to Parent Function Conversions in other sections: You may not be familiar with all functions and features in tables; Here are some topics to review: Basic Parent Functions We will probably review some popular parent functions and you will work with them to learn how to convert functions – how to move them. We call these basic functions parent functions because they are the simplest form of such functions, that is, they are as close as possible to the source \(\sol({0,\,0} \right)\. It provides some basic parent functions that you should be familiar with in the chart below. I also included highlights or critical points, points where I would chart the main function. I sometimes call these reference points or anchor points. Know the shapes of these main functions! Even when using T-graphics, you need to know the overall shape of the main functions to know how to convert them correctly! Parent Function Chart Parent Function Chart \(y=x\) Linear, Single Domain: \(\sol(\infty }\right)\) Range: \(\sol(\-\infty , \s.) Last Behavior**: \(\begin{array}{l}x\to -\infty \text{, \x\to \infty text\, \infty },\,\,y\to \infty \end{array}\) Critical points: \(\displaystyle \left({-1,-1} \right),\,\left({0.0} \right),\left({1.1} \right)\) \(y=\sol\ x \right|\) Absolute Value, Dual Domain : \(\sol , \-\infty } \right)\) Range: \(\sol[{0,\infty } \right)\) Last Behavior: \(\begin{array}{l}x\to -\infty \text{, \x\to \infty \x\to \infty \text{ , \\,\,y\to \infty \end{array}\) Critical points: \(\displaystyle \left({-1.1} \right),\,\left({0.0} \right),\left({1.1} \right)\) \(y={x}^{2}}\) Quadratic, Even Domain: \(\left({-\infty ,\infty } \right)\) Range: \(\sol[{0,\infty } \right)\) Last Behavior: \(\begin{array}{l}x\to -\infty \text{ , \l,y\x\to \infty \text{, \l,y\to \infty \text{, \l,y\to \infty \end{array}\\ Critical points: \(\displaystyle \left({-1.1} \right),\,\left({0.0}\sa\right)\) \1.1} \right)\) \(y=s\q)\\ \(y=s\q)\) rt{x}\) Radical (Square Root) , Domain: \(\sol[{0,\infty } \right)\) Range: \(\sol[{0,\infty } \right)\) End Behavior: \(\displaystyle \begin{array}{l}x\to 0,\,y\0\x\to \text\text\text\,\l,y\,y\to \infty \end{array}\\ Critical points : \(\displaystyle \left({0.0} \right),\,\left({1.1} \right),\,\sol({4.2} \right)\) \(y={{x}^{3}}\) Cubic, Single Domain: \(\sol(\infty ,\infty } \right)\) Range: \(\sol(\-\infty ,\infty } \right)\) End Behavior : \(\begin{array}{l}x\to -\infty \text{, }\,y\to -\infty \\x\to \infty \text{, }\,\,y\to \infty \end{array}\\ Critical points: \(\displaystyle \left({{-1,-1} \right),\,\left({0.0} \right),\,\left({1.11} \right)\) \(y=\sqrt[3]{x}\) Cube Root , Single Domain: \(\sol({-\infty ,\infty } \right)\) Range: \(\sol({-\infty) } \right)\) Last Behavior: \(\begin{array}{l}x\to -\infty \text{, }\,y\to -\infty \\x\to \infty \text{, \l,\,y\to \infty \end{array}\) Critical points: \(\displaystyle \left({-1,-1} \right),\,\left({0.0} \right),\,\left(\1.1} \right)\) \(\begin{array}{c}y={b}^{x}},\,b>1,\\(y>\)\{2}^{x}}}\end{array}\) Parent, Domain: \(\sol({-\infty ,\infty } \right)\) Range: \(\left(\0,\infty } \right)\) End of Behavior : \(\begin{array}{l}x\to -\infty \text{, }\,y\to 0\\x\to \infty \text{, \l,\,y\to \infty \text{, }\,y\to 0\\x\to \infty \text{, \l,\,y\to \infty \end{array}\) Critical points: \(\displaystyle \left({-1,\frac{1}{b}} \right),\,\sol(\0.1} \right),\,\sol({1,b} \right)\) Asymptote: \(y=0\) \) \(\begin{array}{c}y={b}\left(x \right)\,\,\,b>1\,\{2}\} Log, What Impact : \(\sol(\-\infty ,\infty } \right)\) Last Behavior: \(\{begin{}l}x\to {{0}^{+}}\text{ , }\,y\to -\infty \\text{, }\,y\to \end{array}\) Critical points: \(\displaystyle \left(\\frac{1}{b},-1} \right),\,\left({1.0} \right),\,\left(\b.1} \right)\\) Asy Mpmptote: \(x=0\) \(\displaystyle y=\frac{1}{x}\) Rational (Reverse), Single Domain: \(\sol({-\infty ,0} \right)\cup \left({0,\infty } \right)\) Range : \(\left, \-\infty ,0} \right)\cup \left({0,\infty } \right)\) Last Behavior: \(\begin\array}{l}x\to -\infty \text{ , }\l\y\to 0\\x\to \infty \text{, }\,\,y\to 0\end{array}\\ Critical points: \(\displaystyle \left({-1,-1} \right),\left({1.1} \right)\) Asimptotlar: \(y=0,\,x=0\) \(\displaystyle y=\frac{1}{x}^{2}}}}}}Rational (Reverse Square), Even Domain: \(\sol({-\infty ,0} \right)\cup \left({0 \infty } \right)\) Range: \(\sol({0,\infty } \right)\) Last Behavior: \(\begin array}{l}x\to -\infty \text{ , \l,y\to 0\x\to \infty \text{, }\,y\to 0\end{array}\\ Critical points: \(\displaystyle \left({-1,\,1} \right),\left({1,1} \right)\) Asimptots: \(x=0,\l,y=0\) \(y=\text{int}\left(x \right)=\left\lfloor x \right\rfloor \) Greatest Integer*, What Domain:\sol(\-\infty ,\infty } \right)\) Range : \(y:y\in \mathbb{Z}\\text{ (integers)}\) Last Behavior: \(\begin{array}{l}x\to -\infty \text{ , }\,y\to -\infty \\x\to \infty \text{, \l,y\to \infty \end{array}\) Critical points: \(\displaystyle \begin{array}{l}x:\left[{-1.0} \right)\,y:-1\\x:\left[{0.1} \right\,\y:0\\x:\left[{1.2} \right)\,y:1\end{array}\) \(y=C\) (\(y=2\)) Fixed, Dual Domain: \(\sol({-\infty) \infty } \right)\) Range: \(\(y:y=C\)\) End Behavior: \(\begin{array}{l}x\to -\infty \text{ , }\,y\to C\\x\to \infty \text{, }\,y\to C\end{array}\) Critical points: \(\displaystyle \left({-1,C} \right),\,\left({0.C} \right),\,\left({1,C} \right)\) *Sometimes called Step Function returns the largest integer below or equal to a number (consider rounding to a number). \(y=\sol\lceil x \right\rceil \) has at least an integer function, which is at least greater than or equal to a number (consider rounding to an integer). **Notes on End Behavior: To obtain the final behavior of a function, we look at the \(x\) smallest and largest values and see which direction \(y\) is going. All functions have the defined end behavior; for example, there are no recent behaviors (called periodic functions) that go back and forth with \(y\) values and never go up or down. Most of the time, our last behavior is similar to this:\(\displaystyle \begin{array}{l}x\to -\infty \text{, \l,\l\x\to \infty \text{, \l,\,y\to \infty \text{, \l,\,y,y\to \,\end{}}) and \(y\) For example, the last behavior of a line with a positive bevel is\ (\begin{array}{l}x\to -\infty \text{, }\,y\to -\infty \\x\to \infty \text{, }\l,\,y\to \infty \end{array}\) and the final behavior of a negative beveled line: \(\begin{array}{l}x\to -\infty \text\\, \\x\to \infty \text{, \,y\to \\to\text\text\array}\\\}\ One way to consider the last behavior is \(\displaystyle x\to -\infty \), what's going on with \(y\) on the left side of the chart, and \(\displaystyle x\to \infty \) is to look at what is happening with \(y\) on the right side of the chart. There are a few exceptions; for example, sometimes it starts from \(x\) 0 (as a radical function), \(x\) we do not have a negative part of the end behavior. Additionally, when \(x\) starts very close to 0 (as in the log function), we specify that \(x\) 0 is started by a positive (right) (and \(y\) is down); we specify this as \(\displaystyle x\to {{0}^{+}}\text{, }\,y\to -\infty \). General Transformations of Functions Again, the parent functions assume that we are the simplest form of the function; that is, if the function either passes the resource \(\sol ({0.0} \right)\) or does not go through the resource, it is not scrolled in any way. When a function is scrolled, stretched (or compressed), or returned from its parent function in any way, it is said to be converted and is a transformation of a function. T-charts are extremely useful tools when dealing with transformations of functions. For example, if you know that the quad master function \(y={x}^{2}}\) is converted 2 units to the right and 1 unit down (not just a slip, a stretch, or flip), we can create the original t-chart by following the conversion points outside the original points. We can then draw external (new) points to get the newly converted function: Transformation T-chart Graphic Quadratic Function \(y={x}^{2}}\) Transform function 2 units to the right and 1 unit down. x + 2 x y y – 1 1 –1 1 0 0 –1 3 1 1 0 Transformed: Domain: \(\sol(\-\infty ,\infty } \right)\) Range: \(\sol[{-1,\-\infty } \right)\) We must be careful when looking at the equation of the function being moved. When functions are converted Outside the \(f(x)\) section, move the function up and down and do normal math, as we will see in the following examples. These are vertical transformations or translations and affect the \(y\) portion of the function. When conversions are made within the \(f(x)\) section, move the function back and forth (but do the opposite math – because you move everything to the other side to insequit x). These are horizontal transformations or translations and affect the \(x\) portion of the function. There are several ways to perform transformations of parent functions; I like to use T-graphics, because they work continuously. And in most t-charts, just to make the graphics look better, I included more of the critical points above. Vertical Transformations Here are the rules and examples of when functions are converted on the outside (notice that \(y\) values are affected). T-charts include points (sorted pairs) of the original parent functions, as well as converted or scrolled points. Note that the first two transformations are translations, the third is an expansion, and the last is the reflection forms. Note that absolute value conversions will be discussed more expensively in the Absolute Value Conversions Section! What The Transformation Does Sample Chart \(f\sol(x \right)+b\) Translation Chart move up or move \(b\) units are shifted to each point \(b\) units in the chart. \(x\)'s stay the same; Add \(b\) to \(y\) values. Parent: \(y={x}^{2}}\) Converted: \(y={x}^{2}}+ \,2\) x y y+2 –1 1 3 0 2 1 1 3 Domain: \(\sol({-\infty }\infty } \infty } \right)\) Range: \(\left[{2,\l,\,\infty } \right)\) \(f\sol(x \right)-b\) Move down the Translation Graphic \(b\) units scroll down from each point \(b\) units in the chart. \(x\)'s stay the same; Remove \(b\) from \(y\) values. Parent: \(y=\sqrt{x}\) Converted: \(y=\sqrt{x}- \,3\) x y-3 0 0 –3 1 1 –2 4 2 –1 Domain: \(\sol[{0,\l)\,\infty } \right)\) Range: \(\sol[{-3,\,\,\infty } \right)\) \(a\,\cdot f\left(x \right)\) Dilation Chart graphic vertically \(a\) (sometimes called dilation). \(a<1\), note that the graphic is compressed or minimized. Each point in the chart stretches the \(a\) units. \(x\)'s stay the same; Multiply \(y\) values by \(a\). Parent: \(y={x}^{3}}\) Converted: \(y={4x}^{3}}\) x y 4y –1 –1 –4 0 0 0 1 1 1 4 Domain: \(\sol({-\infty , \infty } \right)\) Range: \(\sol({-\infty ,\infty } \right)\) \(-f\sol(x \right)\) Around the Mirror Graph \(x\)-axis. Each point in the chart is vertically translated. \(x\)'s stay the same; Multiply \(y\) by \(-1\). Top: \(y=\sol| x \right|\) Converted: \(y=-\sol| x \right|\) x y –1 1 –1 0 0 0 1 1 1 Domain: \(\left) \(\infty }\right)\) Range: \(\sol(\0\\ \f\sol(x \right)\ \right|\) Absolute Value \(y\) (Here's Absolute Conversion section) reflects the section below the \(x\)-axis of the chart (negative \(y\)'s) along the \(x\)-axis. Release positive \(y\)'s is the same. \(x\)'s stay the same; Gets the absolute value of \(y\). Parent: \(y=\sqrt[3]{x}\) Converted: \(y=\sol| \\sqrt[3]{x}} \right|\) x y |y| –1 –1 1 0 0 0 0 0 1 1 1 Domain: \(\sol({-\infty ,\infty } \right)\) Range: \(\sol[{0,\infty } \right)\) Horizontal Transformations Are rules and examples where functions are converted internally (\(x\) values are affected). Note that when \(x\) values are affected, you do the math in a contrasting way than the function appears: if you are adding it in, \(x\); if you remove it, \(x\); \(x\); if you are dividing it, you multiply it by \(x\). If there is a negative value inside, you flip the \(\boldsymbol{y}\) axis (multiply \(x\) by \(x\) \(x\) as you do with \(y\) for vertical flips. Note that absolute value conversions will be discussed more expensively in the Absolute Value Conversions Section! (You may find this interesting that a vertical stretch moves in the same way as a horizontal compression, and vice versa, since something is up stretch, we are making it thinner.) What The Transformation Does Sample Chart \(f\sol({x+b} \right)\) Translation Chart left \(b\) units (Contrast when the change is in the parameter or below the radical mark.) Each point in the chart shifts \(b\) volumes to the left. \(y\)'s stay the same; Remove \(b\) from \(x\) values. Parent: \(y={x}^{2}}\) Converted: \(y={{\left({x+2} \right)}}{2}}\) x – 2 x y –3 –1 1 –2 0 0 –1 Domain: \(\left({-\infty ,\inft y } \right)\) Range: \(\left] {0,\,\infty } \right)\) \(f\sol({x-b} \right)\) Moving translation chart to the right \(b\) units shift every point in the chart to the right \(b\) units. \(y\)'s stay the same; Add \(b\) to \(x\). Parent: \(y=\sqrt{x}\) Converted: \(y=\sqrt{{x- \,3}}\) x + 3 x y 3 0 0 4 1 7 4 2 Domain: \(\sol[{-3,\infty } \right)\) Range : \(\sol[\,\,\infty } \right)\) \(f\cdot x} \right)\) Compress dial compression graphic \(a\) units horizontally with a scale factor (\(\displaystyle \frac{1}{a}\)) Each point in the chart is compressed horizontally \(a\) volumes. \(y\)'s stay the same; Multiply \(x\) values by \(\displaystyle \frac{1}{a}\). Parent: \(y={x}^{3}}\) \(\frac{1}{4}x\) x y \(-frac{1}{4}\) –1 –1 0 0 0 \(\frac{1}{4}\) 1 Domain: \(\sol({-\infty ,\infty } \right)\) Range: \(\infty ,\infty } \right)\) \(f\left({-x} \right)\) Image Flip graphic The \(y\) axis is rotated around each point \(y\) axis in the chart. \(y\)'s stay the same; Multiply \(x\) by \(-1\). Parent: \(y=\sqrt{x}\) Converted: \(y=\sqrt{{-x}\) –x x y 0 0 0 –1 1 1 –4 4 2 Domain: \(\sol ({-\infty ,0} \right]\) Range: \(\) Range left[{0,\infty } \right)\) \(f\sol(\\sol| x \right|} \right)\) Absolute Value \(x\) (other examples in the Absolute Value Transformation section) Throw away negative \(x\)'s; positive \(x\)'s \(y\)-along the axis. Positive \(x\)'s stay the same; negative \(x\)'s get \(y\)'s positive \(x\)'s. Parent: \(y=\sqrt{x}\) Converted: \(y=\sqrt{{\left| x \right|}} \) x y New y –4 NA 2 –1 NA 1 0 0 1 1 4 2 Domain : \(\sol(\-\infty ,\infty } \right)\) Range: \(\sol[{0,\infty } \right)\) Most of the issues you will receive will involve mixed conversions or multiple conversions, and we need to worry about the order in which we perform conversions. It usually doesn't matter if we make x or y changes first, but we must perform conversions in \(x\)'s and \(y\)'s in the following order. Note that this is similar to the order in PEMDAS (packs, bases, multiplication/division, and addition/subseation). When fulfilling these rules, the internal x coefficients must be 1; for example, \(y={\left({4\left({x+2} \right)}^{2}}\) must be \(y={{\left({4x+8} \right)}^{2}}\) (by factoring). If you didn't learn it this way, see the IMPORTANT NOTE below. Row here: First perform a flip between axes (negative marks). Perform the next Stretch and Reduction (multiplication and splitting). Perform the horizontal and vertical shifts last (insert and subse this). Since we can think of the first two steps as negative stress/compression, we can do steps 1 and 2 together (sorting doesn't matter). I want to take critical points and maybe a few more points of the main functions and perform all the conversions at the same time with a t-chart! We only do multiplication/splitting at \(x\) or \(y\) points, and then add/subst. That'll make it a lot easier! Remember once again that since there is no x alone (1 coefficient) inside, we have to achieve this in this way by factoring! For example, we must change \(y={{\left(4x+8} \right)}}{2}}\text{ to }y={{\left({4\left({{x+2} \right)} \right)}{2}}\). Let's try to chart this complex equation and show you how easy it is with a t-chart: \(\displaystyle f(x)=-3{{\left({2x+8} \right)}^{2}}+10\) (For this example, \({2}^{2}}\) \(3\sol({{{2}^{2}}} \right)=12\) we can move out to get a vertical stretch, but we can't do this for many functions.) Before we can perform horizontal translations, we must factor \(x\) into it alone. That's the last thing that happens. \(\displaystyle f(x)=-3{{\left({2\left({x+4} \right)} \right)}}{2}}+10\) What we need to do now is look at what's being done for external (\y\) and make all the moves at once, following the full math. Then look in (for \(x\)'s) and make all the moves at the same time, but do reverse math. We do this with a t-chart. We begin with the parent function \(f(x)={{x}^{2}}\\\. If we look at what we are doing outside of the square one, \(\displaystyle \left({2\left({x+4} \right)\ \right)\), \(x\)-axis (minus sign), stretch with 3 factors and add 10 (scroll up to 10). These are things that we do vertically, or \(y\). If we look at what we are doing now, we multicly it by 2, which means that we divide it by 2 (horizontal compression \(\displaystyle \frac{1}{2}\)) by a factor, and we add 4, which means that we take out 4 (left shift of 4). Note that we do the opposite when dealing with \(x\). Also keep in mind that you always have to multiply or split first with our points, and then add and substly (kind of like PEMDAS). Note: You may see mixed transformations such as \(\displaystyle g\left(x \right)=a\cdot f\left({\left(\\frac{1}{b}} \right)\left({x-h} \right)\ \right)+k\). or coordinate rule \(\displaystyle \left) {x,y} \right)\to \left({bx+h,\,\,month+k} \right)\), \(a\) vertical stretch, \(b\) horizontal stretch, \(h\) right horizontal shift, and \(k\) upward vertical scrolling. Conversion \(\displaystyle f(x)=-3{{\left({2\left({x+4} \right)} \right)}{2}}+10\), \(a=-103\), \(\displaystyle b=\frac{1}{2}\,\,\text{or}\,\\5\), \(h=-4\) and \(k=10\). Our conversion is \(\displaystyle g\left(x \right)=-3f\left({2\left({x+4} \right)} \right)+10=g\left(x \right)=-3f\left({\frac{1}{\frac{1}{2}}} \right)\left)\left({x-\left({-4} \right)} \right)\10\) \(\left({x,\,y} \right)\to \left ({.5x-4,-3y+10} \right)\). (You can also see this as \(g\left(x \right)=a\cdot f\left({b\left({x-h} \right)} \right)+k\). displaystyle \left({x,\,y} \right)\to \sola({\frac{1}{b}x+h,\,ay+k} \right)\); the result will be the same.) Here is the t-chart with the original function and then external transformations. Now we can chart external points (unsealed points) to get a graphic of the transformation. I also included a description of how to convert this parabola without a t-chart, as we did here in the Quadratics section. t-chart Converted Chart Top: \(y={{x}^{2}}\) (Quadratic) Converted: \(\displaystyle f(x)=-3{{\left({2\left({x+4} \right)} \right)}{2}}+10\) y changes: \(\displaystyle f(x)=\color{blue}{{{-3}}{{\left({2\left({x+4} \right)} x changes: \(\displaystyle f(x)=-3{{\left({\color{blue}{2}\left({x\text{ }\color{blue}{{{\text{ }4} \right)} \right)}^{2}}+10 \) (\x), \(normal for y\\) \(\left({x,\,y} \right)\to \sola({.5x-4,-3y+10} \right) \) .5x – 5x 4 x y –3y + 10 –5 –2 4 –2 –4 –4.5 1 1 1 7 –4 0 0 10 –3.5 1 1 7 –3 2 4 –12 Domain: \(\sol({-\infty ,\infty } \right)\ Range: \(\sol({-\infty ,10} \right]\) How to make a T-chartless graphic: Because it is a parabola and is a peak, the starting point of the transformation \(\sol({-4.10} \right)\). Note that the coefficient is –12 (\({2}^{2}}\) by moveing it out and multiplying it by –3). Then the vertical stretch is 12, and the parabola faces down because of the negative sign. The main chart quadratic goes up 1 and over (and back) to get another two points, but with a vertical stretch of 12, we go from the 1st and down 12th peaks (and back). Now there are two points where you can draw vertex parabola. IMPORTANT NOTE: In some books, \(\displaystyle f\left(x \right)=-3{\left({2x+8} \right)}^{2}}+10\), they may not take into account the inner 2, but you may not be enough to change the order of the transformation on \(\boldsymbol{y}\). In such cases, the transformation will be horizontal shifts, horizontal reflections/extensions, vertical reflections/extensions, and then vertical shifts. For example, for this problem, you move to the left 8 for \(\boldsymbol{y}\), and then compress it with the \(\displaystyle \frac {1}{2}\) factor\\boldsymbol{x}\) (opposite PEMDAS). Then you want to perform \(\boldsymbol{y}\) (vertical) changes normally - reflect and stretch 3 first, and then slide up to 10. That is, \(\displaystyle {\left({x,\,y} \right)\left({\frac{1}{2}\left({x-8} \right),-3y+10} \right)}\). Try a t-chart; you get the same t-chart as above! Conversions in Function Notation (based on Charts and/or Points) You may also be asked to transform a function using a chart and individual points; in this case, you will most likely be transformed in the function notation. Note that we may need to use several points from the chart and convert them to make sure that the converted function has the correct shape. Here are some examples; the second example is \(x\); For more details, see Absolute Value Conversions. Points with Original Chart and Function Transformation Name Sample Function Sample Function: Domain: \(\sol[{-4.5} \right]\ Range: \(\sol[{-7.5} \right]\) Key Points: Conversion: \(\displaystyle f\left(\-\frac{1}{2}\sol({x-1} \right)} \right)-3\) \(y\) changes: \(\display\fstyle\ frac{1}{2}\left({x-1} \right)\color{blue}{{-\text{}\ \3}}} \(x\) changes: \(\displaystyle f\left(\\color{blue}{{-\frac{1}{2}}}\left({x\text{ }\color{blue}{-text}right)\3\not Returns at \(\boldsymbol{y}\)-axis, has a horizontal extension of 2, right to 1, and down 3. Key Points Converted: (\(x\)) –2x + 1 x y y – 3 9 –4 5 2 1 0 1 –2 –3 2 2 –1 –9 5 –7 –10 Converted Function: Domain: \(\sol[{-9.9} \right]\) Range: \(\left[{-10.2} \right]\) Conversion: \(\displaystyle f\left(\\sol| x \right |+1} \right)-2\) \(y\) changes: \(\displaystyle f\left({\left| x \right|+1} \right)\color{blue}{{underline{{-\text{ }2}}} \(x \) changes: \(\displaystyle f\left({\color{blue}{{underline{{\left| x \right|+1} \right)-2\): Note that this transformation has been down to 2 and left 1. Then, for the inner absolute value, we get rid of the values to the left of the \(y\)-axis and replace the chart with the values to the right of the \(y\)-axis to make it symmetric with the \(y\)-axis. Let's do this with graphics. First, move down 2 and left 1: Then project the right side along the \(y\)-axis to make it symmetrical. Converted Function: Domain: \(\sol[{-4.4} \right]\ Range: \(\sol[{-9.0} \right]\) Tricky! Draw points in the same order originally to make it easier! And if you're having trouble drawing graphics from converted ranked couples, remember, just score more points for a new map than the original chart! Note: You can also give a random point, say \(\sol ({8,-2} \right)\), and give the converted coordinates for the chart \(y=-6g\left({-2x} \right)-2\) point. To do this, to get a converted \(y\), multiply the \(y\) portion of the point by –6, and then remove 2. To get a converted \(x\), multiply the \(x\) portion of the period by \(\displaystyle -\frac{1}{2}\) (contrasting math). New point \(\sol({-4.10} \right)\). Functional Representation Conversion Using Algebra We can say that we want to use a function notation transformation to convert a parent or non-parent equation. We can do this without using the t-chart, but using substitution and algebra. For example, if we want to convert \(f\sol(x\right)={x}^{2}}+4\) conversion \(\displaystyle -2f\left({x-1} \right)+3\), we can replace \(x-1\) in the original equation with \2 instead of \(x-1\) and then add 3. For example: \(\displaystyle -2f\left({x-1} \right)+3=-2\left[{{{\left({{{\left({x-1} \right)}{2}}+4} \right]+3=-2\sol({{{x}{2}}}-2x+1+4} \right)+3=-2{x}{2}}}+4x-7\} We used this method to convert part-by-piece functionality. More Examples of Mixed Conversions: Several more instances with different parent functions (using t-charts). Don't worry if it disappears completely with its superseal and daily functions; supersection functions and Logarithmic Functions sections. In addition, the last type of function is a rational function to be discussed in the Rational Functions section. Transformation T-chart/Domain and Range Chart \(\displaystyle y=\frac{3}{2}{{\left({-x} Parent function: \(y={x}^{3}}\) Note that for this function, we may also have exported the negative sign (so that we can affect \(y\)) and get the same graphic. –x x y \(\frac{3}{2}y+2\) 1 –1 –1 .5 0 0 0 2 –1 1 1 3.5 Domain: \(\left({-\infty ,\infty } \right)\) Range: \(\left({-\infty ,\infty } \right)\) \(\displaystyle y=\frac{1}{2}\sqrt{{-x}}\) Parent function: \(y=\sqrt{x}\) –x x y \(\frac{1}{2}y\) 0 0 0 0 –1 1 1 .5 –4 4 2 1 Domain: \(\left({-\infty ,0} \right]\) Range: \(\left[{0,\infty } \right)\) \(y={{2}^{x-4}}}+3\) Parent function: \(y={{2}^{x}}\) For exponential functions, use –1, 0, and 1 for the \(x\) values for the parent function. (Easy way to remember: base \(x\)). x + 4 x y y y + 3 3 –1 .5 3.5 4 0 1 4 5 1 2 5 Domain: \(\sol(\-\infty ,\infty } \right)\ Range: \(\sol{ {3,\infty } \right)\) Asymptote: \(y=3\ ) \(begin{array}{l}y=\log \left({2x-2} \right)-1y=\log \left({2\left({x-1} \right)} \right)-1\son{array}\) Parent function: \(y=\log \sol(x \right)\) For daily and ln functions –1, 0, and \(y\) values for the parent function. (Note: \(y={\\log }_{3}}\left({2\left({x-1} \right)-1\), for example, \(x\) values for parent function \(\displaystyle \frac{1}{3},\,1,\text and\,\\3\)). .5x + 1 x y y – 1 1 1.05 .1 –2 1.5 1 0 –1 6 10 1 0 Domain: \(\sol({1,\infty } \right)\) Range: \(\sol(\-\infty ,\infty } \right)\) Asymp Tote: \(x=1\) \(\displaystyle y=\frac{3}{2-x}\\\,{3}\,\l,\l:\ \(\displaystyle y=\frac{1}{3} <3> <2>{x}\) –x + 2 x y 3y 3 –1 –1 –1 –3 1 1 1 3 Domains: \(\sol(\-\infty ,2} \right)\cup \left({2,\infty } \right)\) Range: \(1 –1 –3 1 1 3 Domains \left({-\infty ,0} \right)\cup \cup left({0,\infty } \right)\) Asimptots: \(y=0\) and \(x=2\) Where there is a mixed transformation with the Greatest Integer Function (sometimes called the Fold Function). Note how we can use ranges as \(x\) values to draw the converted function: Transformation T-chart/Domain and Range Chart \(\displaystyle y=\left[\frac{1}{2}x-2} \right]+3\) \(\displaystyle y=\sol [\frac{1}{2}\sol ({x-4} \right)} \right]+3\) Parent function: \(y=\sol[x \right]\) Note how we have to remove \(\displaystyle \frac{1}{2}\) to do it correctly. 2x + 4 x y y + 3 [0, 2) [–2, –1) –2 1 [2, 4) [–1, 0) –1 2 [4, 6) [0, 1) 0 3 [6, 8) [1, 2) 1 4 [8, 10) [2, 3) 2 5 Domains: \(\sol(\-\infty ,\infty } \right)\) Range: \(\y\y\in \mathbb{Z}\}\text{ (integers)}\) You may be asked to type a converted equation, give graphics. Most of the time, I can say just by looking, but sometimes you have to use a point or two. And since you have to be careful and control your work, the order of conversions can be important. When solving transformations in a chart, \(a\) (vertical stretch) or \(b\) (horizontal in equation \(\displaystyle g\left(x \right)=a\cdot f\left({\left({\frac{1}{b}} \right)\left({x-h} \right)} \right)+k\). Sometimes the problem shows which parameters to search for (\(a\), \(b\), and so on. For others, such as polynomials (such as quadratics and cubics), a vertical stretch mimics a horizontal compression, so it is possible to factor out a coefficient to open a horizontal stretch/compression of a vertical compression/stretch. (For more complex charts, you may want to perform a downturn in the calculator to get the function, if you are allowed to get a few points and do so). In the Absolute Value Conversions section, we will find an equation converted from an absolute value chart. Some problems include: Converted Chart Import Equation Type the general equation of the cubic equation on the form: \(\displaystyle y={{\left({\frac{1}{b}\left({x-h} \right)} \right)}^{3}}+k\) We see the center point, or critical point \((\left({4,\,-5} \right)\): \(\displaystyle y={{\left(\\frac{1}{b}\left({x+4} \right)} \right)}{3}}-5\). Be careful to get back and to the next points, we see that there is a horizontal stretch of \(3\) back /over and up /up \(1\), so \(3\), so \(b=3\). (This means \(\displaystyle \frac{1}{{3}^{3}}}=\frac{1}{{27}}\)) it appears to be vertical compression. So we have \(\displaystyle y={{\left({\frac{1}{3}\left({x+4} \right)} \right)}^{3}}-5\). Try - it works! Find the equation for this chart in any format: There is usually a general method here that you can use: we see that this is a cubic polynomial chart (top chart \(y={x}^{3}}\)), but rotated around the \(x\) \(y\)-axis; let's use the \(x\)-axis for simpliability. The equation will be \(y=a{{\sol({x+b} \right)}^{3}}+c\, \(a\) and \(2\) and left \({3}1\). We \(a\); \(\sol({1,\,-10} \right)\): \(\begin{align}-10&=a{{\left({1+1} \right)}^{3}}+2\\-10&=8a+2\\8a&=-12;\l,\,\frac{{12}}{8}=-\frac{3}{2}\end{align}\\ Equation of the chart: \(\displaystyle y=-\frac{3}{2}{\left(\x+1} \right)}{3}}+2\). Be sure to check your response by wearing graphics or more points! √ Find the equation for this chart in any format: The chart looks like a quaadratic with a peak \(\sol({-1,\,-8} \right)\), \(8\) is a shift down and \(1\) to the left. This will give us an equation of \(y=a{{\sol({x+1} \right)}^{2}}-8\), (not coincidentally!). We \(a\); \(\sol({1,\0} \right)\): \(\begin{align}y&=a{{\left({x+1} \right)}}{2}}-8\} \right)}{2}}-8\\8&\4a;\,a=2\end{align}\\\ The equation for the chart is\ \(y=2{{\left({x+1} \right)}^{2}}-8\). Note: we may have noticed too \(1\) and \(2\) will spread up instead of \(1\), or \(1\) will normally spread up with \(y={x}^{2}}\). This means that our vertical stretch is \(2\). Find the equation for this chart in any format: The chart appears rational with the center of asymptots in \(\sol({-2,\,3} \right), where 2 shifts left and 3 upwards. This gives us an equation of \(\displaystyle y=a\left{1} {\frac{1}{{{x+2} \right)+3\), \(x=-2\) and \(y=3\). We \(a\); \((0.4)\): \(\begin{align}y&=a\left({\frac{1}{x+2}} \right)+3\\4&=a\left(\frac{1}{0+2} \right)+3\1&\frac{a}{2} {1} <7>;\,\,a=2\end{align}\\ The equation for the chart is\ \(\displaystyle y=2\left(\\frac{1}{{x+2}} \right)+3,\,\text{or }y=\frac{2}{x+2}\)+3\). Note: We may have noticed that the chart goes over 1 and above 2 from the center of the asimptots, over 1 and over 1 \(\displaystyle y=\frac{1}{x}\). This means that our vertical stretch is 2. Find the equation for this chart with a 0.5 base and \(-1\) horizontal shift): We see that this superstal chart is a horizontal asimptot in \(y=-3\) and \(y=a{{\left({{5} \right)^{x+1}-3\) with horizontal shift so far. When you have such a problem, first use any point with 0 in it; the system will be easiest to solve. \(a\) first \(\sol({0.-1} \right)\\ \ \(c}y=a{{\left) \.5} \right}{{x+1}}}-3;\\,-1=a{\left({5} \right ^{0+1}-3;\,\,a=4\y=4{\left({.5} \right)}^{x+1}-3\end{}\) Rotation Transformations You may be asked to perform a rotation transformation in a function (you usually see them in the Geometry class). It includes replacing a counterclockwise 90° rotation with \(\left ({x,y} \right)\) and \(\sol({-y,x} \right)\), counterclockwise 180° contains a rotation \(\left({x,y} \right) with \(\left({-x,-y} \right)\) and 270° counterclockwise rotation \(\left({x,y} \right)\) and \(\left({y,-x} \right)\). An example here: Conversion Example Graphic Rotation chart counterclockwise 270° Top: \(y={x}^{2}}\) \((x,y)\) and \((y,–x)\) y x y –x 4 –2 4 2 1 –1 1 1 0 0 0 0 0 1 1 –1 –1 4 2 4 –2 Rotated Function Domain: \(\sol[{0,\infty } \right)\) Range: \(\sol({-\infty ,\infty , \infty } \right)\) Conversions of Reverse Functions When it comes to conversions that we learned about Reverse Functions here you may be asked to compare the original functions and reverse functions. Note that an inverse function is a function that is modified by \(x\) \(y\), so all conversions made on \(x\) are performed on \(y\): What conversions are made to the reverse function if a cubic function is projected on the y-axis and scrolled down 2 units? Solution: We need to do on the opposite variable. This means that the reverse of this function is stretched horizontally by a factor of 3, reflected on the \(x\) axis, and shifted to the left 2 units. Note that here is a graph of two functions: Examples of Finding Inverses with Limited Domains can be found here. Super function conversions applications you may see a word problem that is used in Parent Function Conversions, and you may only have to use what you know to scroll functions (replaced by a solution from above your head). Here's an example: Transformation Application Problem Solution The following polynomial chart shows the profits made by selling math books after September 1. Polynomial \(p\sol(x \right)=5{{x}^{3}}-20{{{x}^{2}}+40x-1\, \(x\) is the number of weeks after September 1. But the publisher of the math books was a week behind; what will this new chart look like and what will be the new (converted) function? Because we shift time to 1 week during the week, we change the chart horizontally or change the inside or \(x\) values. When we move our first profit 1. \(x\) to the right, we take \(x\) values and remove them so that the new polynomial \(d\sol)=5{\left ({x-1} \right)}^{3}}-20{\left({x-1} \right}^{2}+40\left\i\. Do you see how easy it is, knowing what we know about converting the main functions? On Absolute Value Conversions - you're ready! Report this ad <

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