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| The goal of this activity is to help you understand how the graph of a function can be translated vertically (up or down) and horizontally (left or right) by adding to or subtracting from the output or the input.  | C:\Users\wilkied\AppData\Local\Temp\Texas Instruments\TI-SmartView CE for the TI-84 Plus Family\Capture1-1667753492563.png |

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| In this activity, the movements of the parent functions $f\left(x\right)= x^{2}$ and $f\left(x\right)= x^{3} $will be explored. You will be using the **Transformation Graphing App** and the program **MOVEIT**, downloaded by your teacher. First, access the App by pressing **apps** and selecting **Transfrm**. Press any key to start. You will now access the **MOVEIT** program by pressing **prgm**. If you are using a TI-84 Plus CE without Python, you will select **MOVEIT**. If you are using a TI-84 Plus CE with Python, you will press **1: TI-Basic** and then select **MOVEIT**. On the Home screen, two options will appear. Option 1 will graph the parent function $f\left(x\right)= x^{2}$ and option 2 will graph $f\left(x\right)= x^{3}$. Press **2nd [quit]** to exit a graph. Press **enter** immediately to run the program again. For each problem in this activity, look at the transformation of both types of functions.C:\Users\wilkied\AppData\Local\Temp\Texas Instruments\TI-SmartView CE for the TI-84 Plus Family\Capture1-1667786111046.png C:\Users\wilkied\AppData\Local\Temp\Texas Instruments\TI-SmartView CE for the TI-84 Plus Family\Capture2-1667786141089.png C:\Users\wilkied\AppData\Local\Temp\Texas Instruments\TI-SmartView CE for the TI-84 Plus Family\Capture3-1667786186949.png**Problem 1 –** $f\left(x\right)\rightarrow f(x-b)$Use the left and right arrow keys to change the value of **B only**. Leave C = 0. You will need to first determine the value of B in each question.Let’s see what you remember about transforming $f\left(x\right)\rightarrow f(x-b)$**:**In questions **1** and **2**, describe the transformation for each graph as compared to the graph of the parent function $f(x)$, use your handheld to verify your answer. 1. $f(x-2)$ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 2. $f(x+5)$ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 3. In general, describe the transformation of $f\left(x\right)\rightarrow f(x-b)$and explain your reasoning.\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**Problem 2 –** $f\left(x\right)\rightarrow f\left(x\right)+c$Use the up and down arrow keys to toggle to **C** and then the left and right arrow keys to change thevalue of **C only**. Leave B = 0. Let’s see what you remember about transforming $f\left(x\right)\rightarrow f\left(x\right)+c$**:**In questions **4** and **5**, describe the transformation for each graph as compared to the graph of theparent function $f(x)$, use your handheld to verify your answer.  4. The graph of $f\left(x\right)+4$ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 5. The graph of $f\left(x\right)-3$ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 6. In general, describe the transformation of $f\left(x\right)\rightarrow f\left(x\right)+c$and explain your reasoning.\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**Problem 3 –** $f\left(x\right)= (x-b)^{2}+c$ 7. Describe the transformations of $f\left(x-7\right)+6$ as compared to the parent function $f(x)$.  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 8. In general, describe the transformations of $f\left(x\right)= (x-b)^{2}+c$ when: *b* and *c* are both positive \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ *b* and *c* are both negative \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ *b* is positive and *c* is negative \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ *b* is negative and *c* is positive \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**Problem 4 –** $f\left(x\right)\rightarrow af(x)$In order to transform your function through the multiplication of *a*, press **Y =** and enter **AX2** next to Y1 and **AX3** next to Y2. Press **enter** on the **=** sign to choose the function you want to graph. Press **graph** to explore the transformations. 9. Describe the transformation of $0.5f(x)$ as compared to the parent function $f(x)$.  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_With a classmate, create a table of values comparing the y-values for given x-values for the functions $f\left(x\right)= x^{2}$ and $f\left(x\right)=0.5x^{2}$. For example, when *x = 2*, the corresponding values for the functions are 4 and 2 respectively. In other words, the y-values are “pushed lower” as a result of multiplying by 0.5. This is known as a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. 10. Describe the transformation of $2f(x)$ as compared to the parent function $f(x)$.  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 11. In general, describe the transformation when $0< \left|a\right|<1$ for the graph of $af\left(x\right)$ as compared to  the parent function $f(x)$. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 12. In general, describe the transformation when $\left|a\right|>1$ for the graph of $af(x)$ as compared to the  parent function $f(x)$. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 13. Change the coefficient of the quadratic and cubic functions to -0.5 and then to -2. Describe the  graph of $af\left(x\right)$ when *a* is negative as compared to when *a* is positive. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**Problem 5 –** $f\left(x\right)\rightarrow f(ax)$In order to transform your function through the multiplication of *a*, press **Y =** and enter **(AX)2** next to Y1 and **(AX)3** next to Y2. Press **enter** on the **=** sign to choose the function you want to graph. Press **graph** to explore the transformations. 14. Describe the transformation of $f(2x)$ as compared to the parent function $f(x)$.  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_With a classmate, create a table of values comparing the y-values for given x-values for the functions $f\left(x\right)= x^{2}$ and $f\left(x\right)=(2x)^{2}$. For example, when *x = 2*, the corresponding values for the functions are 4 and 16 respectively. In other words, instead of it taking x = 4 to get y = 16, it took x = 2 to get y = 16, therefore x-values are “pushed lower” as a result of multiplying the x-value by 2 or the x-value was halved. This is known as a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. 15. Describe the transformation of $f(0.5x)$ as compared to the parent function $f(x)$.  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 16. In general, describe the transformation when $0< \left|a\right|<1$ for the graph of $f\left(ax\right)$ as compared to  the parent function $f(x)$. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 17. In general, describe the transformation when $\left|a\right|>1$ for the graph of $f(ax)$ as compared to the  parent function $f(x)$. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 18. Change the sign of the value being multiplied by *x* for the quadratic and cubic functions to -0.5 and then to -2. Describe the graph of $af\left(x\right)$ when *a* is negative as compared to when *a* is positive. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**Further IB Applications**The following diagram shows the graph of the function $y=f(x)$, for $-5\leq x \leq 4$. The points (-5, 4) and (0, 3) both lie on the graph of $f$. There is a minimum at point (-2, -1).Let $g\left(x\right)= -f\left(x-3\right)+2$.(a) Write down the domain of $f$. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_(b) Write down the range of $g$. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_(c) On the graph above, sketch the graph of $g$.Let $h\left(x\right)=f(-3x)$.(d) Describe the transformations of $h\left(x\right)$ as compared to $f(x)$.\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |