Algebra Nomograph

Student Worksheet

Name _____

Class _____

In this activity, you will explore:

- Functions: notation, domain, and range
- Inverse functions

Open the file *PTE-Alg-AlgebraNomograph_EN.tns* on your TI-Nspire™ handheld.

Listen as your teacher explains how the model of the nomograph works. Then open the document *PTE-Alg-AlgebraNomograph_EN.tns* on your TI-Nspire™ handheld and work with a partner to complete the activity (Figure 1).

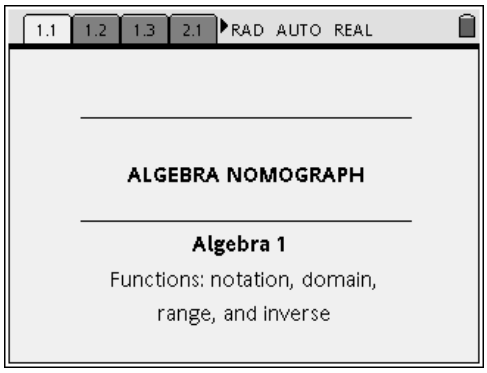

Figure 1

Introduction

A **nomograph** is similar to a function machine in that it relates a number in one set (the *domain*) to a number in a second set (the *range*). The nomograph takes the form of a pair of vertical number lines; the one on the left represents the domain; the one on the right represents the range. The function rule mapping an element in the domain to its corresponding element in the range is shown by an arrow.

Problem 1 – "What's my Rule?"

The first nomograph (representing an unknown function) is shown on page 1.2 (Figure 2).

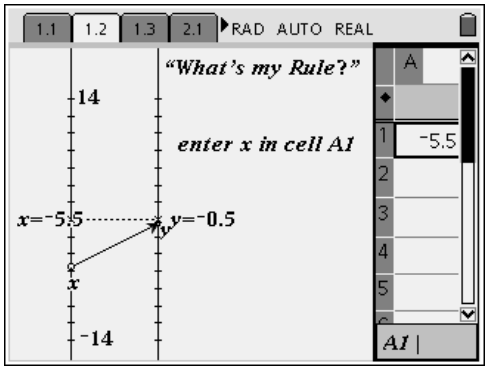

Figure 2

1. Enter a value of *x* into cell A1 of the spreadsheet.
   - The nomograph relates it to a *y*-value by substituting the value *x* into the function's rule.
2. Your task is to find the "mystery rule" for **f1** that pairs each value for *x* with a value for *y*.
3. Once you think you have found the rule, record it below.

   f1(*x*) =

4. Then continue testing your prediction using the nomograph.

Each time you entered a different value for *x*, that value and its corresponding *y*-value were recorded into the spreadsheet on page 1.3 and simultaneously displayed in the scatter plot.

5. Record four such ordered pairs, and draw them on the coordinate grid in Figure 3.

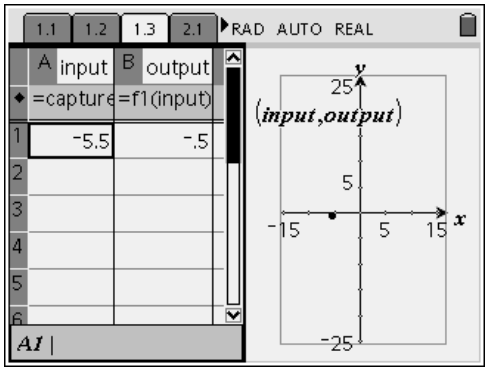

Figure 3

The line through these points is the graph of **f1**(*x*), which you can see has a slope of 1.

6. How can you tell this graph from the nomograph by looking at the arrows for different values of *x*?

Problem 2 – More "What's my Rule?"

The nomograph on page 2.1 follows a different function rule than the nomograph you just saw in Problem 1 (Figure 4).

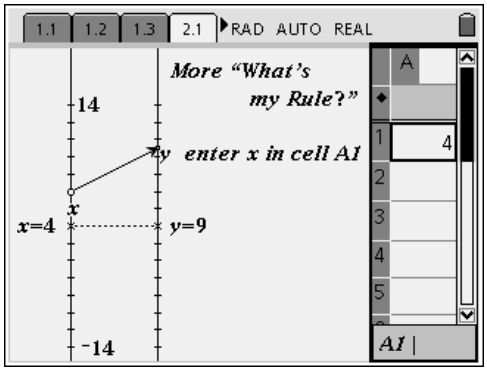

Figure 4

7. As before, enter values for *x* in cell A1, and find the rule for this new function **f1**.

f1(*x*) =

- You may use the resulting ordered pairs in the spreadsheet and scatter plot on page 2.2.

8. Test your rule using the nomograph.

9. What is the slope of this function?

Slope:

10. How do the arrows on the nomograph for this function differ from those in Problem 1?

Problem 3 – The "What's my Rule?" Challenge

Page 3.1 shows a nomograph for the function **f1**(x) = x. The challenge is to make up a new rule for **f1**(x), and have a partner guess your rule by using the nomograph.

11. On the Calculator application on page 3.2, press (menu) (1) (2) for Menu 1:Tools, 2:Recall Definition . . . , and then press (enter) to choose f1 (Figure 5).

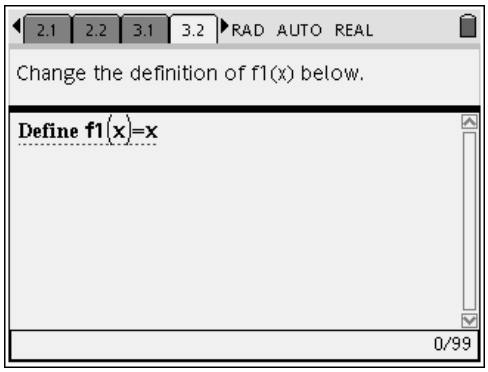

Figure 5

12. Use the (clear) key to erase the current definition and enter your own.

13. Then, exchange handhelds with your partner, who will use the nomograph to discover your rule.

14. Then, repeat.

15. List at least four of the functions you and your partner explored with the nomograph.

$f(x)$ = _____ $f(x)$ = _____ $f(x)$ = _____ $f(x)$ = _____

Problem 4 – Even more "What's my Rule?"

For the nomograph on page 4.1, you change the input, *x*, by grabbing and dragging the base of the arrow (Figure 6). As you move the point up and down, it will "jump" by steps of 2, and the arrow will point to each corresponding *y*-value.

Here, the ordered pairs are not recorded in a spreadsheet, so you will need to record some of your ordered pairs below.

16. Use these ordered pairs, and work with a partner to find the rule for this function.

_____ _____ _____

_____ _____ _____ *y* = _____

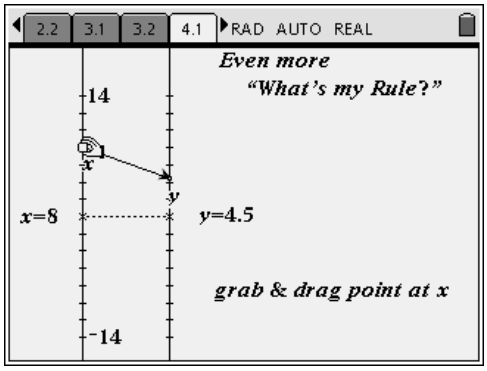

Figure 6

Problem 5 – A more difficult "What's my Rule?"

17. Record ordered pairs and find the rule for the nomograph on page 5.1 (Figure 7).

_____ _____ _____

_____ _____ _____ $y =$ _____

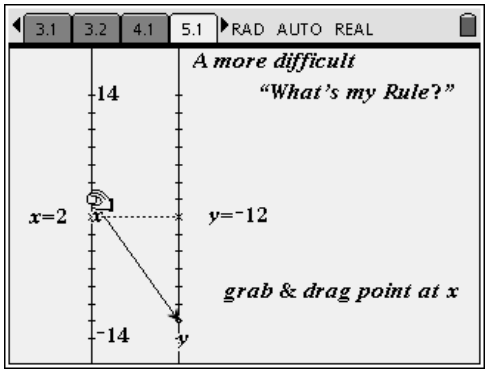

Figure 7

Problem 6 – The case of the disappearing arrow

Page 6.1 displays the nomograph for the function $\mathbf{f1}(x) = \sqrt{6 - x}$.

18. Observe what happens as you grab and drag the base of the arrow (Figure 8).

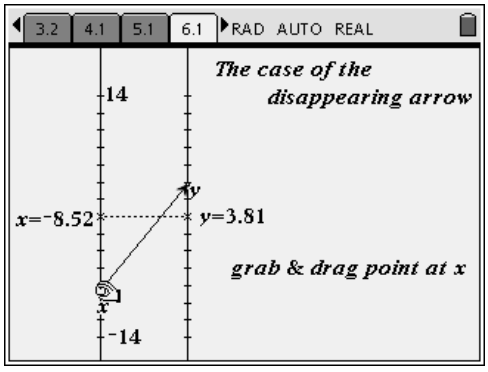

Figure 8

19. When does the arrow disappear?

20. Why does it disappear?

Problem 7 – An inverse function

The "inverse" of a function *f*, denoted f^{-1}, "undoes" the function—it maps a point *y* from the range back to its original *x* from the domain.

A "double" nomograph is shown on page 7.1 (Figure 9). The second arrow represents the rule of the inverse function and the third vertical line displays *z*, the range of the inverse function. On the nomograph, the inverse function maps a point *y* to a point *z* that lines up with point *x*; that is, $x = z$.

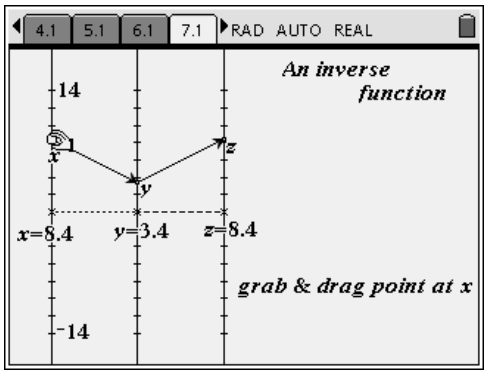

Figure 9

21. Record 3 ordered pairs (*x*, *y*) that belong to **f1**.

22. Use those *y*-values as domain entries to find 3 ordered pairs for $\mathbf{f1^{-1}}$.

f1: _____ _____ _____ $\mathbf{f1^{-1}}$: _____ _____ _____

23. What do you notice about these ordered pairs?

24. Use the ordered pairs to find rules for both functions.

f1(*x*) = $\mathbf{f1^{-1}}(x)$ =

Problem 8 – More inverse functions

25. Explore the nomograph on page 8.1 to find ordered pairs and rules for **f1** and $\mathbf{f1}^{-1}$ (Figure 10).

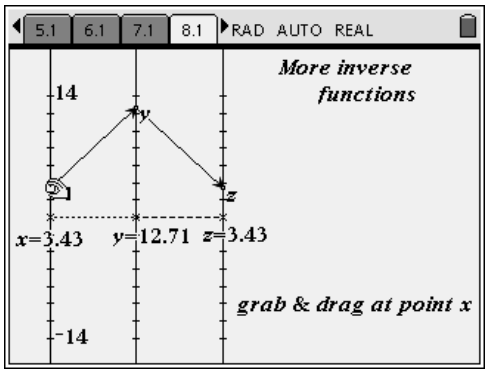

Figure 10

26. Test with different values for *x*.

f1: _____ _____ _____ $\mathbf{f1}^{-1}$: _____ _____ _____

f1(x) = _____ $\mathbf{f1}^{-1}(x)$ = _____

27. On page 8.2, unhide the graphs of **f1**(x), **f2**(x) = $\mathbf{f1}^{-1}(x)$, and **f3**(x) = x.

28. What relationship do you see between these graphs?

