Advanced Algebra Nomograph

AdvAlgNomograph.tns

Name ______________________

Class ______________________

Problem 1 – "What's my Rule?"

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

Enter a value of x into **x:=** . Pressing [enter] accepts the changes.

Your task is to find the "mystery rule" for **f1** that pairs each value for x with a value for y. Once you think you have found the rule, record it below.

- **f1**(x) = _______________

Continue testing your prediction. When you have decided on the function, press the slider to check your result.

Problem 2 – A more difficult "What's my Rule?"

The nomograph on page 2.1 follows a non-linear function rule. Enter a value of x into **x:=** , press [enter], and find the rule for this new function **f1**.

- **f1**(x) = _______________

Test your rule using the nomograph, and then click the slider to confirm your result.

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

Page 3.1 shows a nomograph for **f1**(x) = x. Make up a new rule (of the form $ax + b$ or $ax^2 + b$) for **f1**(x), and have a partner guess your rule by using the nomograph.

Enter your equation into **f1(*x*):=** , press [enter], and then hide your equation by clicking the slider. Exchange handhelds with your partner, who will use the nomograph to discover your rule. Repeat this four times. 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 – The case of the disappearing arrow

Page 4.1 shows a nomograph for the function $\mathbf{f1}(x) = \sqrt{x^2 - 4}$. The input for this nomograph is changed by grabbing and dragging point x. Observe what happens when you drag this point.

- When does the arrow between x and y disappear?

- Why does the arrow between x and y disappear?

Problem 5 – Composite functions: "wired in series"

The nomograph on page 5.1 consists of three vertical number lines and behaves like *two* function machines wired in series. The point at x identifies a domain value on the first number line and is dynamically linked by the function **f1**(x) = 3x – 6 to a range value y on the middle number line. That value is then linked by a second function **f2**(x) = –2x + 2 to a value z on the far right number line.

Either of the two notations **f2(f1(*x*))** or **f2 ◦ f1** can be used to describe the ***composite function*** that gives the result of applying function **f1** *first*, and then applying function **f2** to that result.

For example, the number 4 is linked to 6 by **f1** (because **f1**(4) = 6), which in turn is linked to –10 by **f2** (because **f2**(6) = –10). Grab and drag point x. Set x = 2 and confirm that y = 0 and z = 2.

Find a rule for the single function **f3** that gives the same result as **f2**(**f1**(x)) for all values of x. To test your answer, move point x to check other values. Click the slider to confirm your result.

- **f3**(x) = ________________

Now use the *Calculator* application on page 5.2 to compute and compare the following.

- **f2**(**f1**(3)) = __________ **f1**(**f2**(3)) = __________
- Try other values of x. Does the order in which you apply the functions matter?

Problem 6 – A well-behaved composite function

Some composite functions are more predictable than others. The nomograph on page 6.1 shows the function **f1**(x) = 3x + 3 composed with a mystery function **f2**. Grab and drag point x.

- What do you notice about the composite function **f2 ◦ f1**?

Play "What's my Rule?" to find the rule for **f2**.

- **f2**(x) = ________

Now use the *Calculator* application on page 6.2 to compute and compare the following.

- **f2**(**f1**(3)) = __________ **f1**(**f2**(3)) = __________
- Try other values of x. Does the order in which you apply the functions matter?

Problem 7 – Inverse functions

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. You can think of a function and its inverse as a special case of function composition. (This is what was shown in Problem 6.)

By definition, **f2** is the inverse of **f1**, if and only if:

- **f2**(**f1**(x)) = x for every x in the domain of **f1**, and
- **f1**(**f2**(x)) = x for every x in the domain of **f2**.

In the context of the nomograph, **f2** is the inverse of **f1** if **f2**(**f1**(x)) horizontally aligns with x for all values in the domain of **f1** (i.e. $z = x$), and vice versa.

The nomograph on page 7.1 shows the composite function **f2** ∘ **f1**, where **f1**(x) = $2x + 4$ and **f2**(x) = x. See if you can figure out what the rule for **f2** must be in order for **f1** and **f2** to be inverse functions. change the value of f2(x) to test your answer.

- **f2**(x) = _________________

Problem 8 – Missing arrows in a composition function

The nomograph on page 8.1 shows the composite function **f2** ∘ **f1** where **f1**(x) = $2x - 6$ and **f2**(x) $= \sqrt{x}$. Grab and drag the point at x. Watch as one of the arrows disappears.

- Which arrow disappears?
- When and why does it disappear?

Problem 9 – “Almost” inverses and more disappearing arrows

The nomograph on page 9.1 shows the composite function **f2** ∘ **f1** where **f1**(x) $= \sqrt{x}$ and **f2**(x) $= x^2$. Grab and drag the point at x.

- When does **f2** act like the inverse of **f1**?
- When does **f2** *NOT* act like the inverse of **f1**?
- When and which arrow(s) disappears?

Reverse the definitions, that is, define **f1**(x) $= x^2$ and **f2**(x) $= \sqrt{x}$. Grab and drag the point at x.

- When does **f2** act like the inverse of **f1**?
- When does **f2** *NOT* act like the inverse of **f1**?

When and which arrow(s) disappears? ______________