First Name _____ Last Name _____ Date ___ – ___ – ___ Period ____ Score ____

Learning Objectives.

- Implement the composition of two functions.
- Implement the decomposition of a function into two simpler functions.

Do Now. *Work on the following problems when the teacher is taking attendance and returning works.*
Find the (natural) domain and range of the following functions.

1. $f(x) = -\sqrt{x}$

2. $g(x) = \sqrt{x^2}$

Practice. *In this practice, we review how to "plug in a number", namely, evaluate the function at a number.*
In the following problems, find the value of the function at the given point. If the value is undefined, put **DNE** (Does Not Exist).

1. $f(x) = x^3 + 4x^2 - 10$, find $f(2)$.

2. $g(x) = \dfrac{2}{x+6}$, find $g(10)$ and $g(-6)$.

3. $h(x) = 2x^2 - 3\sqrt{x}$, find $h(9)$ and $h(-9)$.

Discussion. *Composition is just about putting the output of a function/process to the input of another. It's used a lot to organize stuffs in not only mathematics, but also software engineering and almost everything. In other words, it's about building a complex structure from simpler ones. In contrast, decomposition is about break complex things into simpler ones.*

Discuss how the following process can be constructed by composing two sub-processes: You are building a video game, and currently you are working on the AI of the enemies. The goal is simple: the enemy object wants to march toward the player once the player enters its sight. Ignoring all the implementation details of code, write this target process as a composition of two sub-processes.

Examples.

Let $f(x) = x^2 + 1$, $g(x) = x - 2$.

1. Find $f(g(5))$.

2. Find $f(g(x))$. Simplify the answer.

3. Find $g(f(x))$. Simplify the answer.

4. Find $(g(f(5))$.

Notations.

- "$(f \circ g)(x)$" just means $f(g(x))$.

Challenges. If $(f \circ g)(x) = \sqrt[3]{2x - 5}$, what are $f(x)$ and $g(x)$?