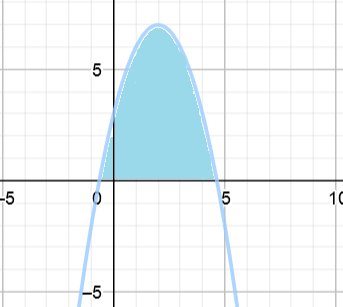
## What’s the point?

The integral seeks to answer one of the classic calculus problems: the area problem, finding the area between a curve and the x-axis.



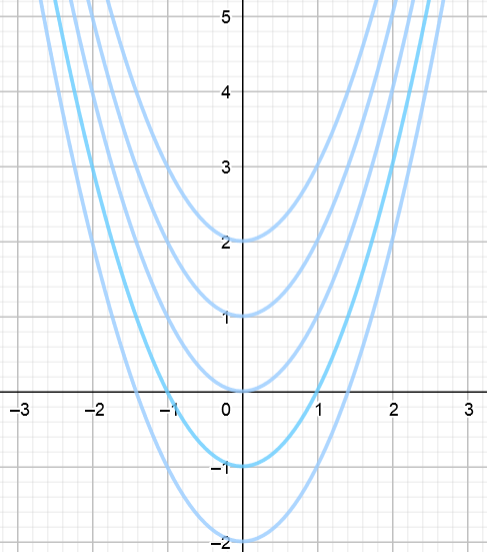
## Indefinite vs Definite Integral

|  |  |
| --- | --- |
| Indefinite Integral | Definite Integral |
| * Family of functions * The antiderivative * Notation: | * A number * The area under the curve * Notation: |

The indefinite integral is the result of undoing the process of deriving a function. Unfortunately, some information about the original function is lost when deriving. Thus, the indefinite integral always results in + c, because the derivative of c is 0, and therefore could be any number.

Ex:

All of these functions have the same derivative



## Fundamental Theorem of Calculus

*If the function is continuous on the closed interval and is an antiderivative of on the interval , then*

*Note: this can also be written as*

This allows us to evaluate the definite integral using the indefinite integral

**EXAMPLE 7:**

Kevin analyzed one of his Rubik’s Cube solves by analyzing how many moves he mad made after each second. Selected values from the graph are in the chart below

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| x – seconds | 0 | 1 | 3 | 5 | 6 | 7 |
| - turns made | 0 | 9 | 25 | 32 | 40 | 53 |

Find including units of measure.

The first fundamental theorem of calculus tells us that

We can then plug in the values we know from

## The Second Fundamental Theorem of Calculus

If is continuous on the open interval containing a, then the area function is an antiderivative of on (). Thus,

We can then relate combine this with the first derivative

so the derivative is

***EXAMPLE 8:***

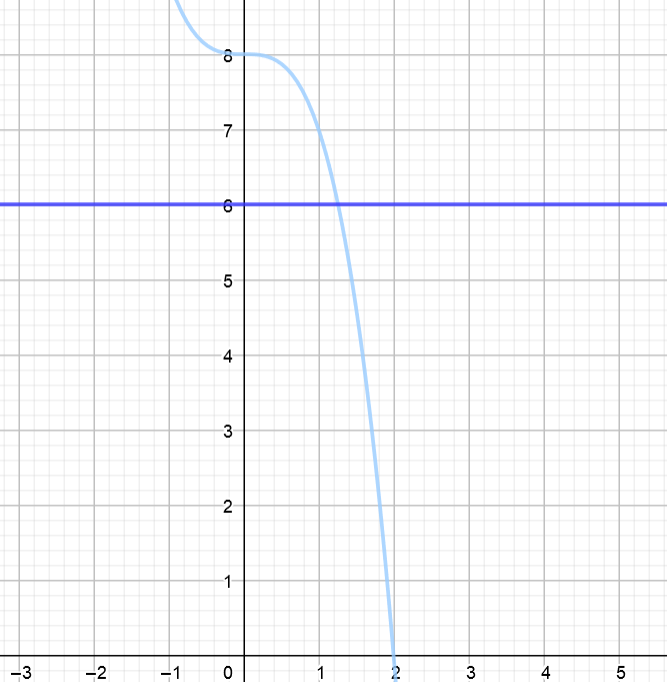
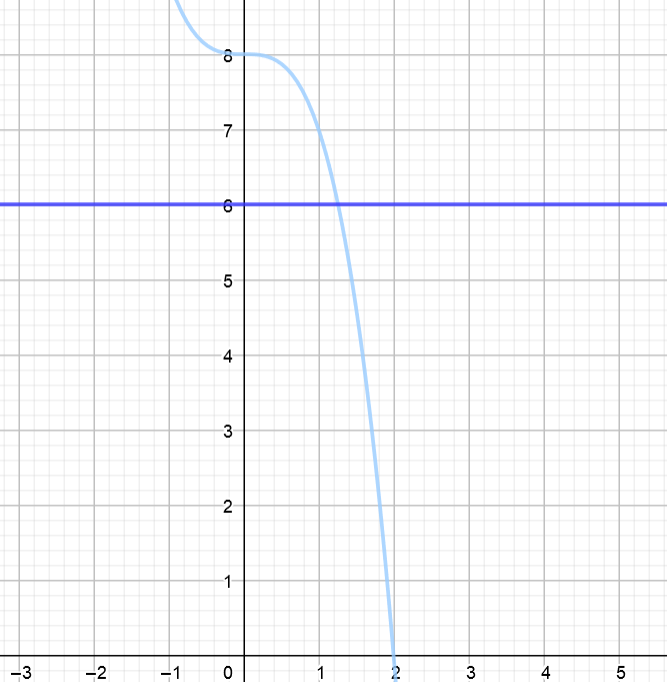
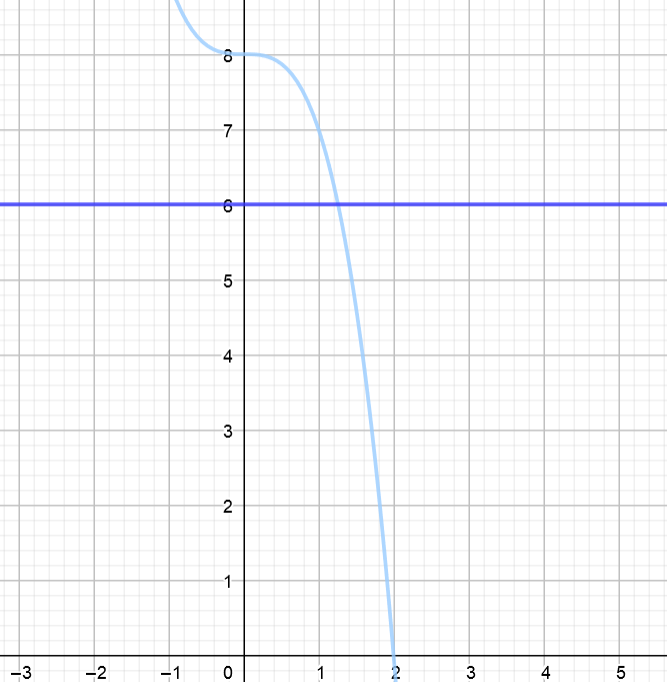
If , find

Using the second fundamental theorem we know that

so

## Average Value

Definition: If is integrable on the closed interval then the average value of on the interval is

How does this work? Dividing the definite integral (area) by the length of the interval results gives you some height. A function with this constant height over the same interval would have the same area.

The average height combined with the interval will result in a rectangle with the same area as the curve.