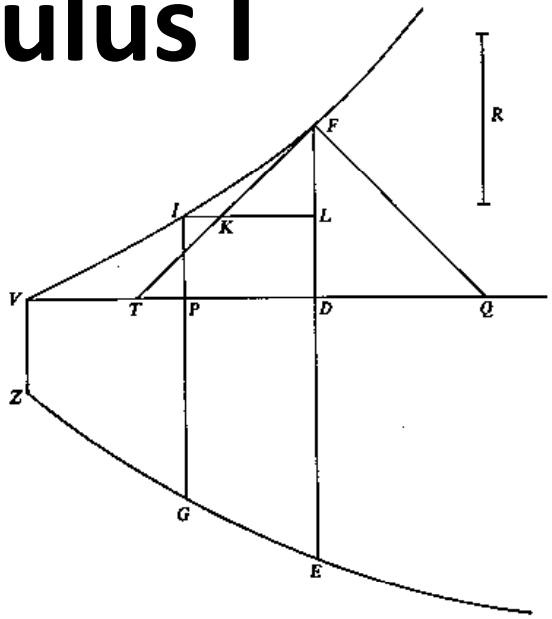
# Lesson 7 – The Fundamental Theorem of Calculus I



# Objectives

- **Understand the first part of the Fundamental Theorem of Calculus.**
- **Have a graphical understanding of the relationship between the derivative and the antiderivative.**
- **Learn and memorize the antiderivatives of the functions $x^n$, $1/x$, $e^x$, $\cos x$ and $\sin x$.**

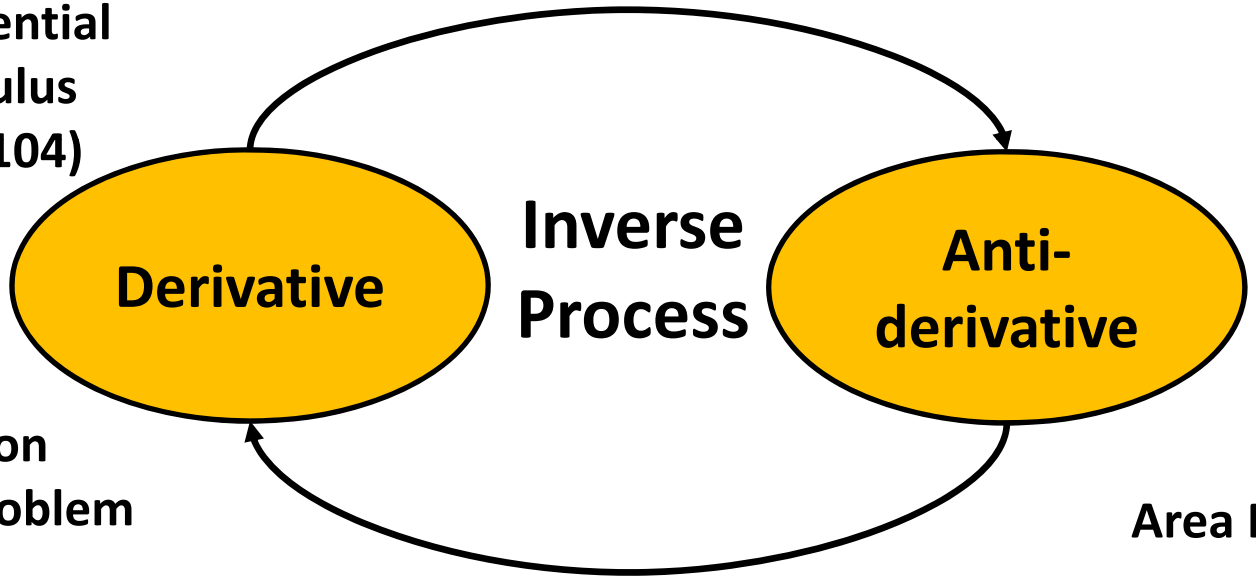
# Overview

•Definite(Geometric/Analytic)

•Indefinite (Algebraic)

Differential Calculus (MA104)

Integral Calculus (MA205)




Based on Tangent Problem Rate

Area Problem

# Definition

## The Fundamental Theorem of Calculus, Part 1

**If *f* is continuous on [*a*, *b*], then function *g* defined by**

$$g(x) = \int_a^x f(t)\ dt \qquad a \le x \le b$$

**is an antiderivative of *f*, that is, $g'(x) = f(x)$ for $a < x < b$.**

**Stewart, p. 381**

# Continuity

**A function *f* is continuous at number *a*, if**

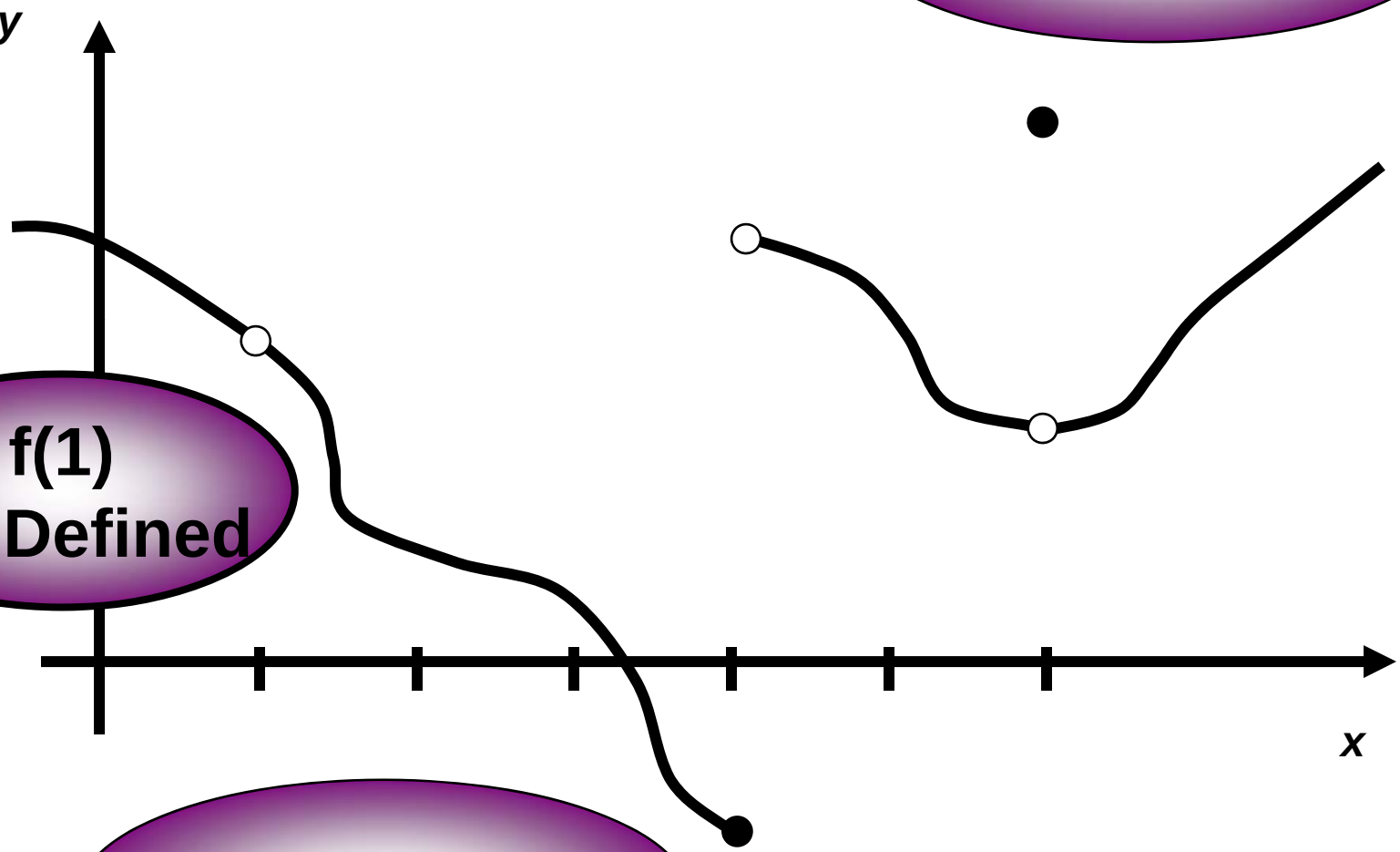
$$\lim_{x \to a} f(x) = f(a)$$

1. ***f*(*a*) is Defined**

2. **$\lim_{x \to a} f(x)$ Exists**

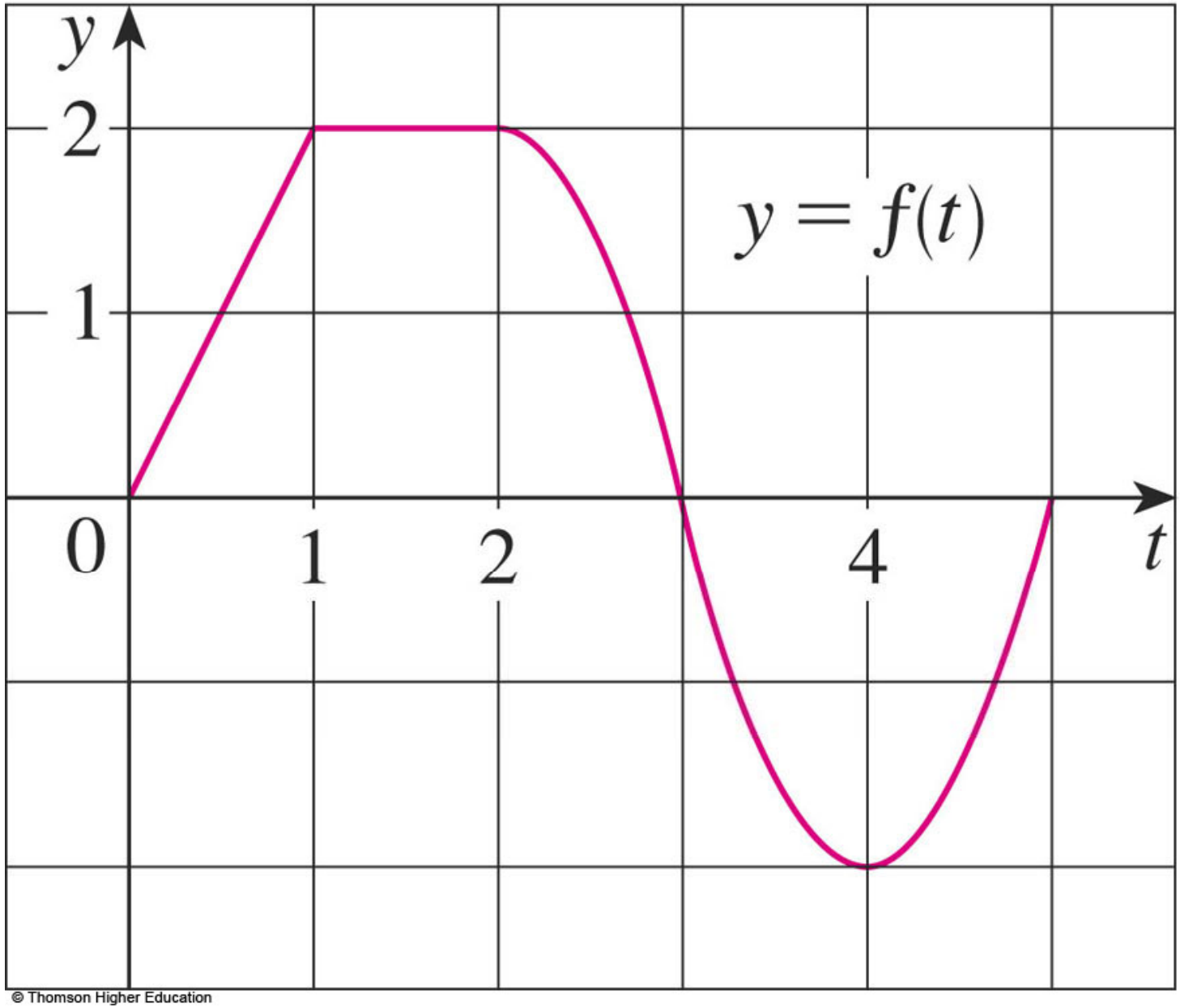
3. **$\lim_{x \to a} f(x) = f(a)$**

$$\lim_{x \to 6} f(x) \neq f(6)$$




f(1)
Not Defined

$$\lim_{x \to 4} f(x) = \text{D.N.E}$$

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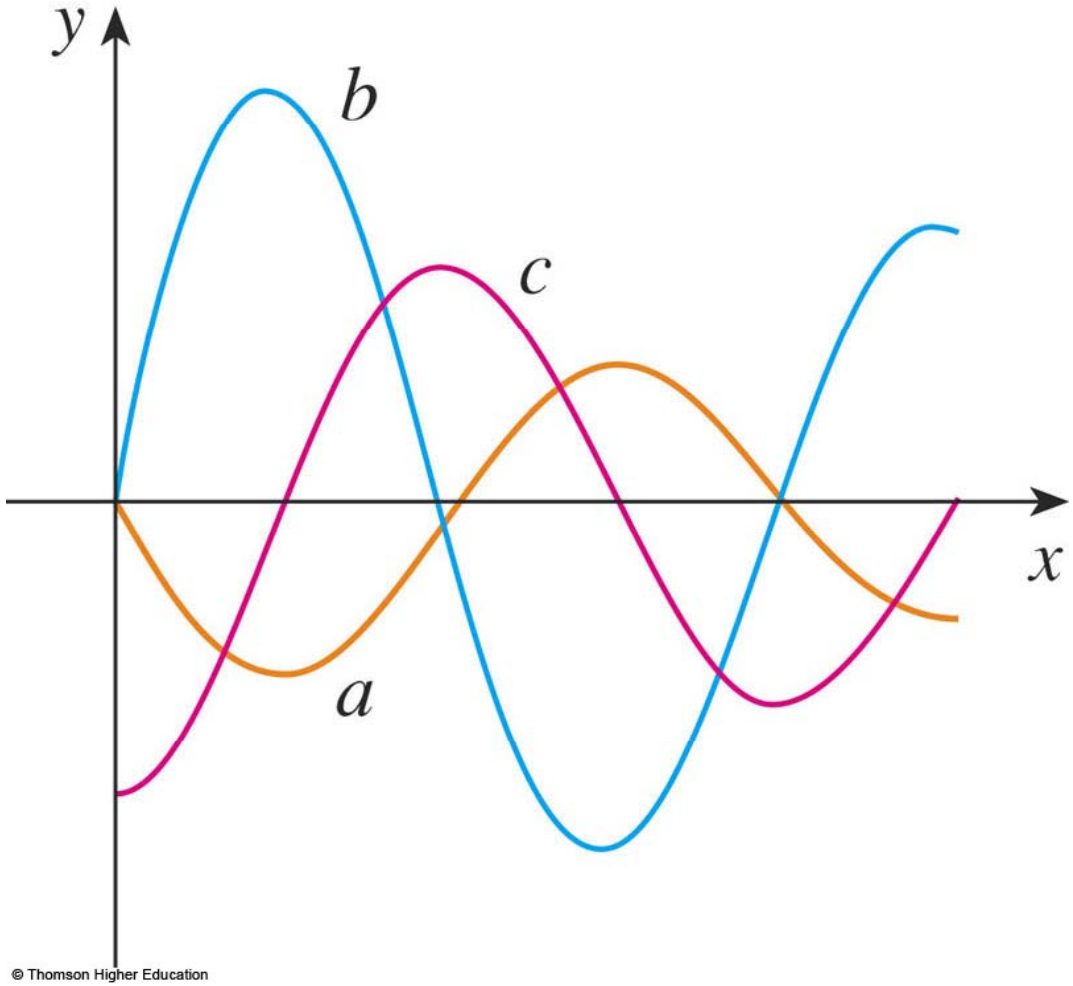
y
b
c
x
a
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# Lesson Link

**The Fundamental Theorem of Calculus, Part 2**

**If *f* is continuous on [*a*, *b*], then**

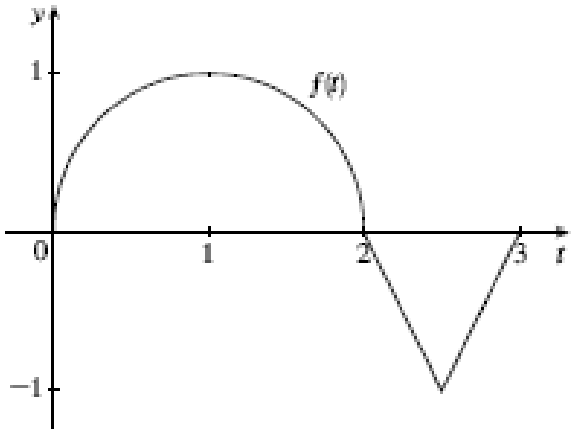
$$\int_a^b f(x)\ dx = F(b) - F(a)$$

**Where *F* is an antiderivative of *f*, that is a function such that *F′* = *f*.**

**Stewart, p. 384**

# Back Up Slides

# Further References

http://www.stewartcalculus.com/tec/tool.php?book=3c3&tool_id=AreaFunctionAndFTC

- Using the graph of $f$ below and setting $g(x) = \int_0^x f(t)\,dt$, evaluate $g(x)$ for $x = 1$, 2, 2.5, and 3, and determine where $g$ has its maximum and minimum values.