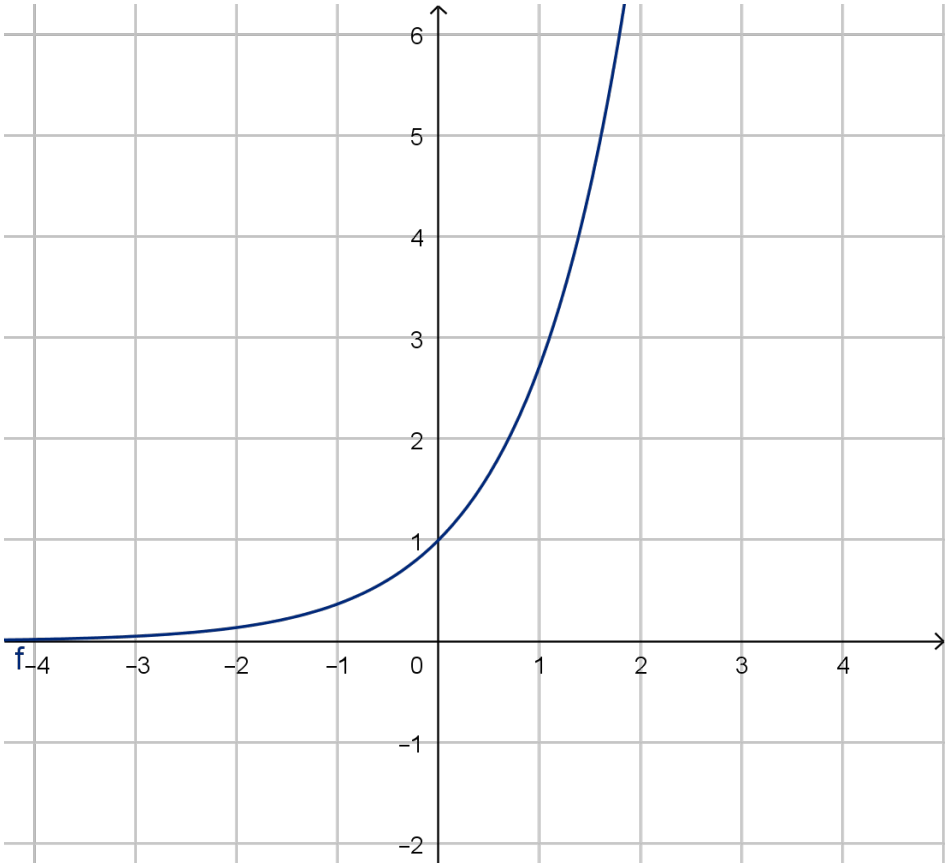
Multivariable Calculus

Course Introduction

Why Multivariable Calculus?

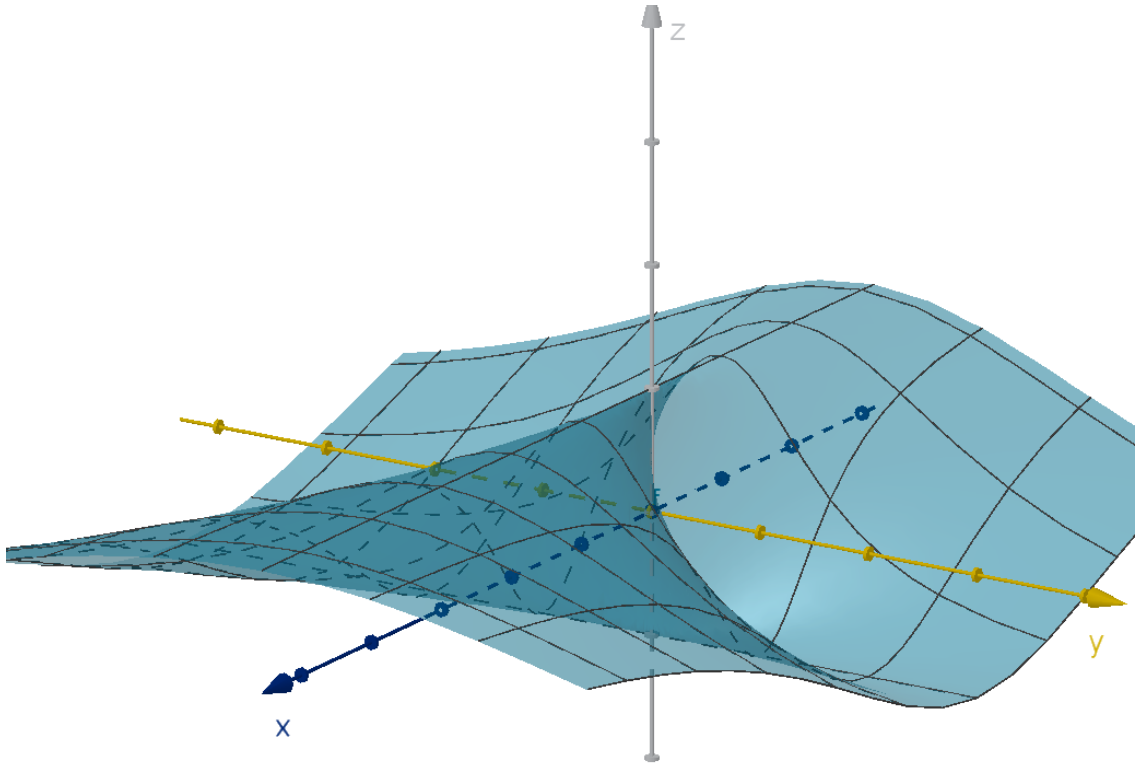
Single variable calculus is concerned with functions like $y = f(x)$ which have a single input and a single output. But many phenomena are too complex to be described this way.



Functions of Multiple Variables

Many measurable quantities can be found to depend on the value of multiple inputs. These are multivariable functions like $z = F(x, y)$, where z is a function of two independent variables. Examples appear in all the sciences

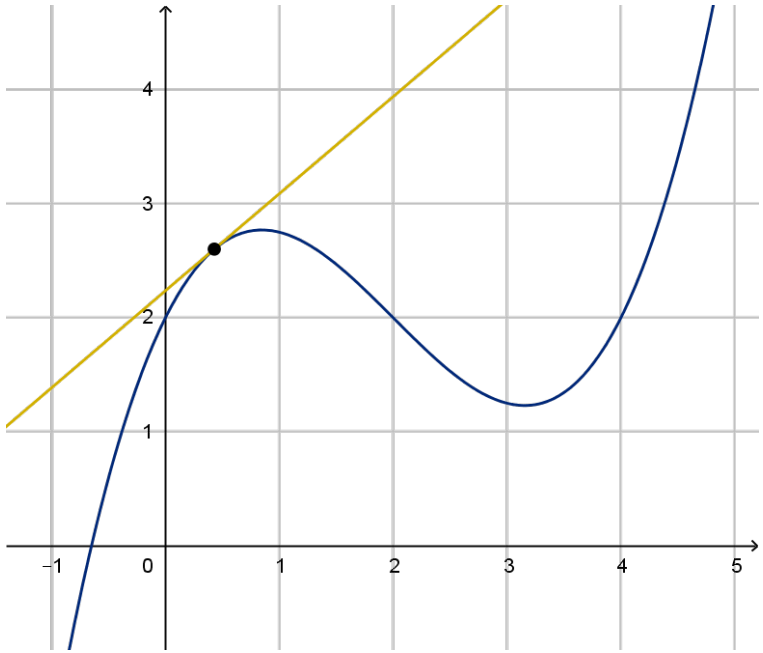
1. Chemistry: $V = \dfrac{nrt}{P}$
2. Physics: $F = \dfrac{GMm}{r^2}$
3. Economics: $P = P_0 e^{rt}$



Calculus on Single-Variable Functions

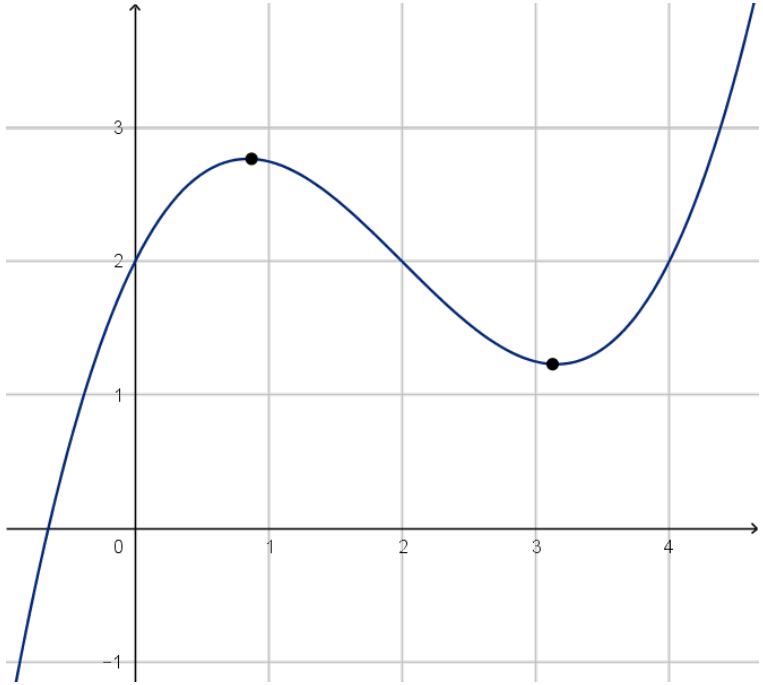
So far in calculus you've developed the tools to answer the following questions about a function of one variable:

1. How quickly does the value of the function change as the input changes?
2. How do we estimate the value of the function near a point?



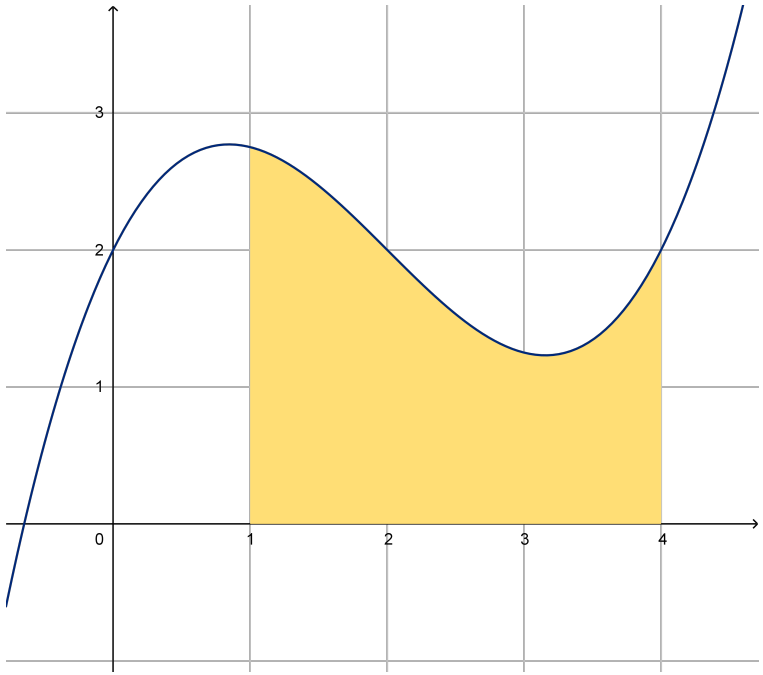
Calculus on Single-Variable Functions

3 What are the maximum and minimum values of the function?



Calculus on Single-Variable Functions

4. What is the area under the graph of the function? What does it mean?

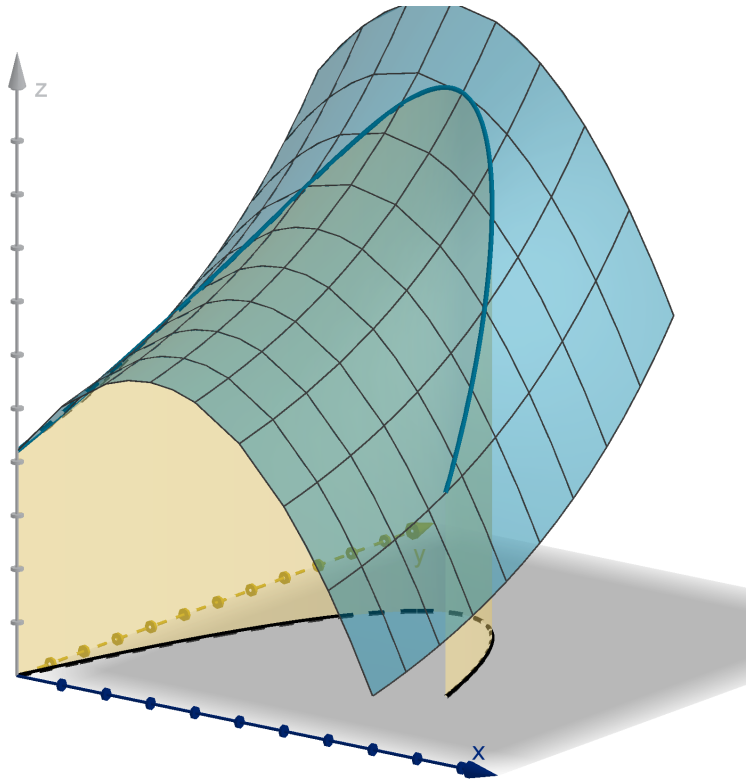


Multi-variable calculus seeks to answer the same questions for functions of multiple variables.

Calculus on Geometric Objects

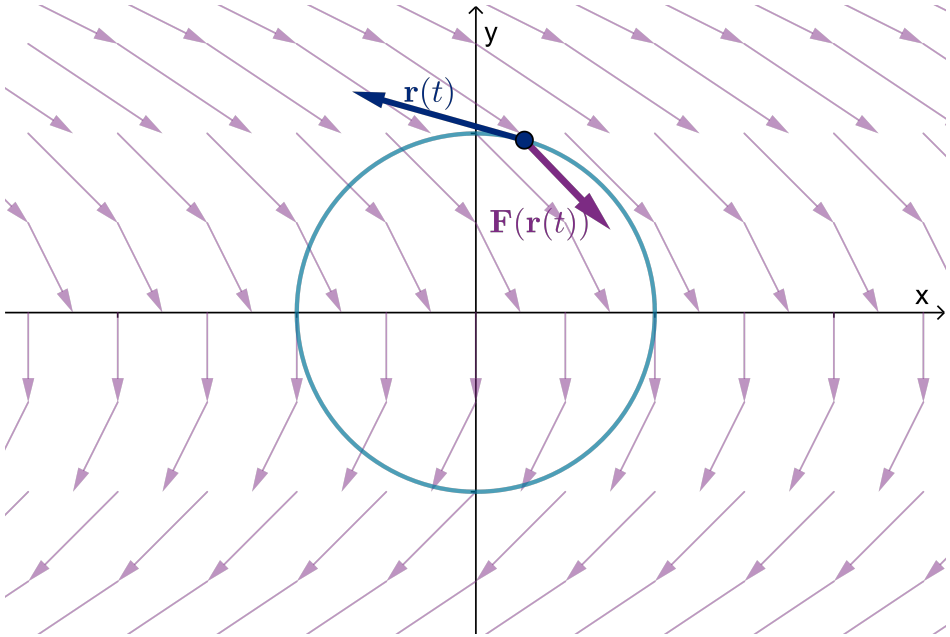
We'll also develop tools for integrating functions over more exciting objects, for instance:

1. The area above a curve in the plane.



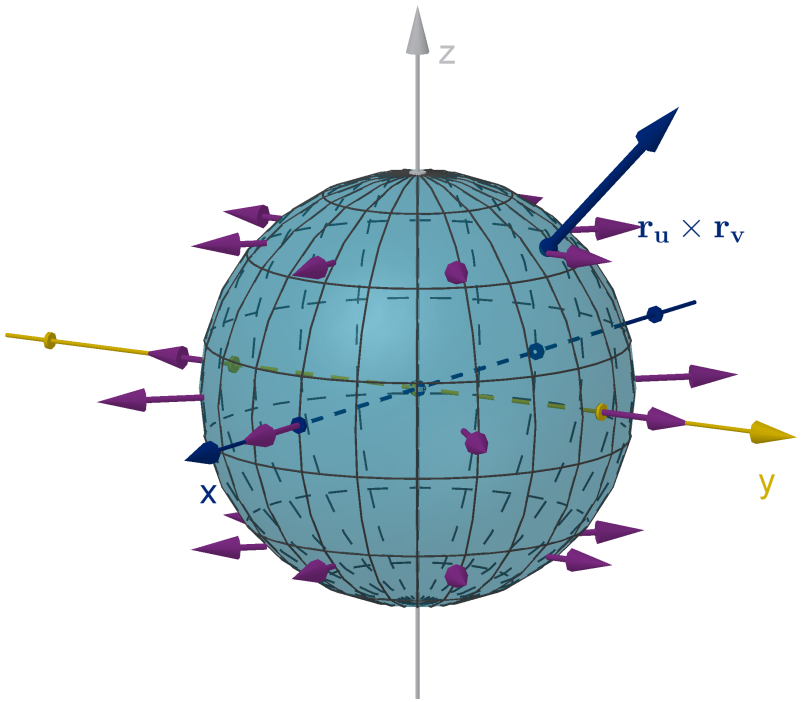
Calculus on Geometric Objects

2. A vector field acting on a particle traveling through it.



Calculus on Geometric Objects

3. A fluid flowing through a surface.



Goals

By the end of this course, we should have the tools to:

- choose a purchase that maximizes utility, given a budget constraint,
- predict the potential error in a chemistry experiment,
- derive the surface area of a sphere, and
- calculate the amount of energy absorbed by a solar panel.