1. Find the area under the graph of \( y = x^2 \) between \( x = 0 \) and \( x = 3 \).
   (a) Explain why this question was meaningless before Descartes and Fermat.
   (b) Find the area by using the definition of area.
   (c) Find the area by using the Fundamental Theorem of Calculus.

2. Consider a force from a point source (such as the force of gravity). Assume that the force is “spread out” evenly in the surrounding (Euclidean) space
   (a) Show that the force must obey an inverse square law. (Note that the intensity \( F \) of the force at a distance \( r \) is the source strength \( S \) spread out over (or divided by) the area of a sphere of radius \( r \).
   (b) If a skunk is suspended on a high pole, would we expect the strength of the odor to satisfy an inverse square law? Explain.

3. An object is dropped from a height \( y_0 \) above the ground. Assume that air resistance on the object reduces its acceleration by an amount proportional to its velocity, and the constant of proportionality is \( 0.4 \text{s}^{-1} \). Set up a differential equation with initial conditions that describe the acceleration of the object at time \( t \).

4. A curve \( y = (x) \) in the plane has the property that the tangent to the curve at the point \( (x, y) \) has slope \( 6x / y^2 \).
   (a) Set up a differential equation that describes the curve.
   (b) Sketch the direction field for the differential equation at the points \((1,1)\), \((1,2)\), \((1,3)\), \((1,4)\), \((2,3)\).
   (c) Suppose the curve passes through the point \((1,1)\).
      (i) Find an approximate solution using step size 0.1.
      (ii) Find an analytic solution using the method of separation of variables.