

Problem 25

For small, slowly falling objects, the assumption made in the text that the drag force is proportional to the velocity is a good one. For larger, more rapidly falling objects, it is more accurate to assume that the drag force is proportional to the square of the velocity.²

- (a) Write a differential equation for the velocity of a falling object of mass m if the magnitude of the drag force is proportional to the square of the velocity and its direction is opposite to that of the velocity.
- (b) Determine the limiting velocity after a long time.
- (c) If $m = 10$ kg, find the drag coefficient so that the limiting velocity is 49 m/s.
- (d) Using the data in part (c), draw a direction field and compare it with Figure 1.1.3.

²See Lyle N. Long and Howard Weiss, “The Velocity Dependence of Aerodynamic Drag: A Primer for Mathematicians,” *American Mathematical Monthly* 106 (1999), 2, pp. 127–135.