



STUDENT VERSION UP DOWN

Brian Winkel
Director SIMIODE
Cornwall NY USA

STATEMENT

An object of mass m is launched vertically upward from ground level with an initial velocity of v_0 and is slowed down by air resistance in the form of a force proportional to its velocity, i.e. $k * v$.

- (a) Draw a free body diagram of the forces acting on the object.
- (b) Use Newton's Second Law of Motion to build a differential equation of motion for its distance from the ground, $s(t)$ in meters at time t in seconds.

Now suppose we know the mass of the object is 2.1 kg, $g = 9.8 \text{ m/s}^2$, $k = 3 \text{ N/(m/s)}$; and the initial height is $s(0) = 0 \text{ m}$.

- (c) Solve the differential equation in (b) for $s(t)$.
- (d) Determine the time and height at which the object comes to rest at the apex of its journey.
- (e) Determine the time at which the object returns to the ground.
- (f) Determine the distance traversed by the object in t seconds.
- (g) Find the time(s) when the upward speed is the same as the downward speed in magnitude and is 6 m/s.
- (h) Find the terminal velocity of the downward falling object if it were allowed to fall indefinitely without striking the ground and determine just how close to this terminal velocity the object comes.