Differential equations honors project

MAT 265, Spring 2017

Drag force

One model for the magnitude of the force due to air resistance is

$$W = \frac{1}{2} c_W \rho A v^2,$$

where c_W is a drag coefficient, ρ is the density of air, A is the cross-sectional area of the projectile, and v is its velocity. Eventually we will put in numbers for the parameters in this model. For now, just use kv^2 to describe this force.

Air resistance always points opposite the direction of an object's motion.

One dimensional motion

In the simplest model, we will assume that the potato is moving in just the vertical direction. At time $t = 0$, the potato is launched upward with an initial speed v_0.

1. Draw a diagram showing the forces on the potato while it is traveling upward. Use W to denote the drag force. Make sure to label the positive direction.
2. Use the description of W above together with Newton's second law to write a differential equation for v that corresponds to your diagram. One side of the equation will have $\dfrac{dv}{dt}$.
3. Solve the problem to obtain $t^\star$, the time when the projectile reaches its maximum height. You should use a definite integral on both sides of your equation instead of adding a $+C$. See me on Thursday after class if you have questions about setting up this step.
4. Repeat the above steps to find a function for the velocity on the trip downward.