Handout: Dropped Stone (based on 4.7#43)

The goal is to answer the following question, which is worded in the way that a question might be worded in a text book.

> *A stone is dropped off 400 foot tower and falls freely. How long will it take the stone to reach the ground, and what will be its speed when it hits the ground?*

In this worksheet, you'll see how such a question would need to be tackled. First of all, variables and directions need to be made precise. And then there would need to be intermediate steps.

Let t be time in seconds, measured from the instant that the stone is dropped. Let position $s$be defined to be zero at ground level, with the positive position axis pointing up.

(a) What is the value of the initial position of the stone, $s(0)$?

(b) What is the value of the initial velocity of the stone, $v(0)$?

(c) The acceleration of the stone is constant. What is the value of the the acceleration, a?

(d) Given that the velocity $v(t)$ is an antiderivative of the acceleration find the general form of the velocity function, $v(t)$. That is, find the general antiderivative of $a(t)$, but instead of calling it $A(t)$, call it $v(t)$.

(e) Knowing what you know about the initial velocity, $v(0)$, find the particular velocity function $v(t)$ that has the correct initial velocity.

(f) Given that the position function is an antiderivative of the velocity, find the general form of the position function, $s(t)$. That is, find the general antiderivative of $v(t)$, but instead of calling it $V(t)$, call it $s(t)$.

(g) Knowing what you know about the initial position, find the particular position function $s(t)$ that has the correct initial position.

The formula that you have found for the position function $s(t)$ gives the position of the stone above ground level at time t.

(h) What is the time when the stone reaches ground level?

(i) What is the speed of the stone when it strikes the ground?