Section A. Mechanics

1. **Coriolis Effect.** A particle of mass m is launched from the Earth's surface at colatitude θ with initial velocity v_0 straight up. A drag force $\vec{F} = -b\vec{v}$ acts on the particle while in flight, where $b = mg/v_0$. You may take the acceleration of gravity to be constant throughout the motion.

   Use a coordinate system with $\hat{i}$ pointing East, $\hat{j}$ pointing North, and $\hat{k}$ straight up, so that the initial conditions are $x(0) = y(0) = z(0) = 0$, $\dot{x}(0) = \dot{y}(0) = 0$, and $\dot{z}(0) = v_0$.

   a) Ignoring the Coriolis force, what is the vertical velocity $\dot{z}(t)$?

   b) Now taking into account the Coriolis force and working at leading order in the Earth's angular velocity $\vec{\omega}$, what are the horizontal components of the velocity, $\dot{x}(t)$ and $\dot{y}(t)$?

   c) Relative to its launch position, where does the particle land? You may assume that v_0 is such that the particle reaches terminal velocity on the way down.