Lab 2: Vertical Mine Dynamics

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PHYS265

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# I. Introduction

This lab focuses on determining the descent time of an object dropped into a vertical mine shaft located at the Earth’s equator, which extends approximately 4 kilometers deep. Initially, we consider an idealized scenario—ignoring air resistance and assuming a uniform gravitational field. We then progressively introduce more realistic factors: variable gravity, atmospheric drag, the Coriolis effect from Earth’s rotation, and the non-uniform density of the Earth. Each addition provides a more accurate understanding of how these forces influence descent time and trajectory.

# II. Fall Time Calculations

We began by applying the basic kinematic equation for free fall under constant gravity, rearranged to isolate time. Using this, we estimated the time it would take for an object to fall 4 km. Then, incorporating numerical solutions using `solve\_ivp` from SciPy, we analyzed the object’s velocity and position under constant gravity. The result showed the object reaches the bottom in roughly 28 seconds—precisely confirmed as 28.6 seconds using event tracking in the solver.