Part I. Pre-lab Homework Problem

A cart rolls down a ramp as shown in the diagram below. Friction is negligible. The initial position, $x_i$ and initial velocity, $v_i$ are both known. The ramp angle $\theta$ is known, and therefore the constant acceleration $g \sin \theta$ is known.

a. Write down the equations for the cart’s position, $x$, and for its velocity, $v$, both as functions of time, $t$. (You may need to draw an FBD and write N11 equations to figure out the acceleration.)

b. Find an expression for the cart’s kinetic energy, $K$, as a function of time.

c. Find an expression for the cart’s potential energy, $U$, as a function of time. Take $U = 0$ where $x = 0$, as indicated in the figure, and note that with the $(x, y)$ coordinate system indicated, as $x$ increases, the height $h$ decreases, so that $U$ also decreases.

d. Add the expressions for $K$ and for $U$ and show that the total mechanical energy is a constant that depends on the initial conditions $x_i$ and $v_i$.

e. Program the spreadsheet labeled “Lab 5 PreLab Excel Programming Problem” with the equations determined above so that you are ready to input your data from the lab.

f. Compare your spreadsheet answers to the supplied PDF files to ensure that your program is working properly. If they don’t match you must determine the reason why before the start of the lab. See your instructor if necessary.