Name: ______________________ Period: ______________

Instructor: Mr. Rodriguez Course: Conceptual Physics A

Term: Winter 2024

Score:__________/??

Lab 2: Uniformly Accelerated Motion

"What we know is a drop, what we don't know is an ocean."

—Isaac Newton

Objective

Show that under uniformly accelerated motion, the position $x(t)$ of an object increases quadratically with time, while the speed $v(t)$ of an object increases linearly with time. If the acceleration is a, this means that the following equations hold true:

1D Kinematics Equations

$$x(t) = \frac{1}{2}at^2 \qquad \text{(position as a function of time)}$$

$$v(t) = at \qquad \text{(velocity as a function of time)}$$

Pre-lab Questions

1. (½ point) Say you have two consecutive position data points $x_1 = 1\,\text{cm}$ and $x_2 = 2\,\text{cm}$. What is the magnitude of the displacement Δx between the two points?

$$\Delta x = x_2 - x_1 = \underline{\hspace{3cm}}$$

2. (½ point) Say that the time elapsed between measuring the two positions above was $\Delta t = 1\,\text{ms}$. How could you use the Δx from the previous problem and the Δt from this problem to find the speed v of the object at that moment in time? The units should be (cm/ms).

$$v = \frac{\Delta x}{\Delta t} = \underline{\hspace{3cm}}$$

3. (½ point) On a position vs. time graph, what does the slope represent physically?

4. (½ point) On a velocity vs. time graph, what does the slope represent physically?

5. (1 point) If you were to set the ticker device to 10 Hz (10 clicks per second),

   (a) How many seconds would pass between each click? Your answer should be a decimal to the hundredths place (i.e., two decimal places). (HINT: Remember, 1 Hz = 1/s)

   (b) What would this be in milliseconds? (1 second = 1000 ms)

Materials

Each group will require:

- A ticker device with an attached circle of carbon paper
- A car
- An inclined car track
- Blue sticky tape
- A meter stick
- A one meter long strip of white ticker tape

Procedure

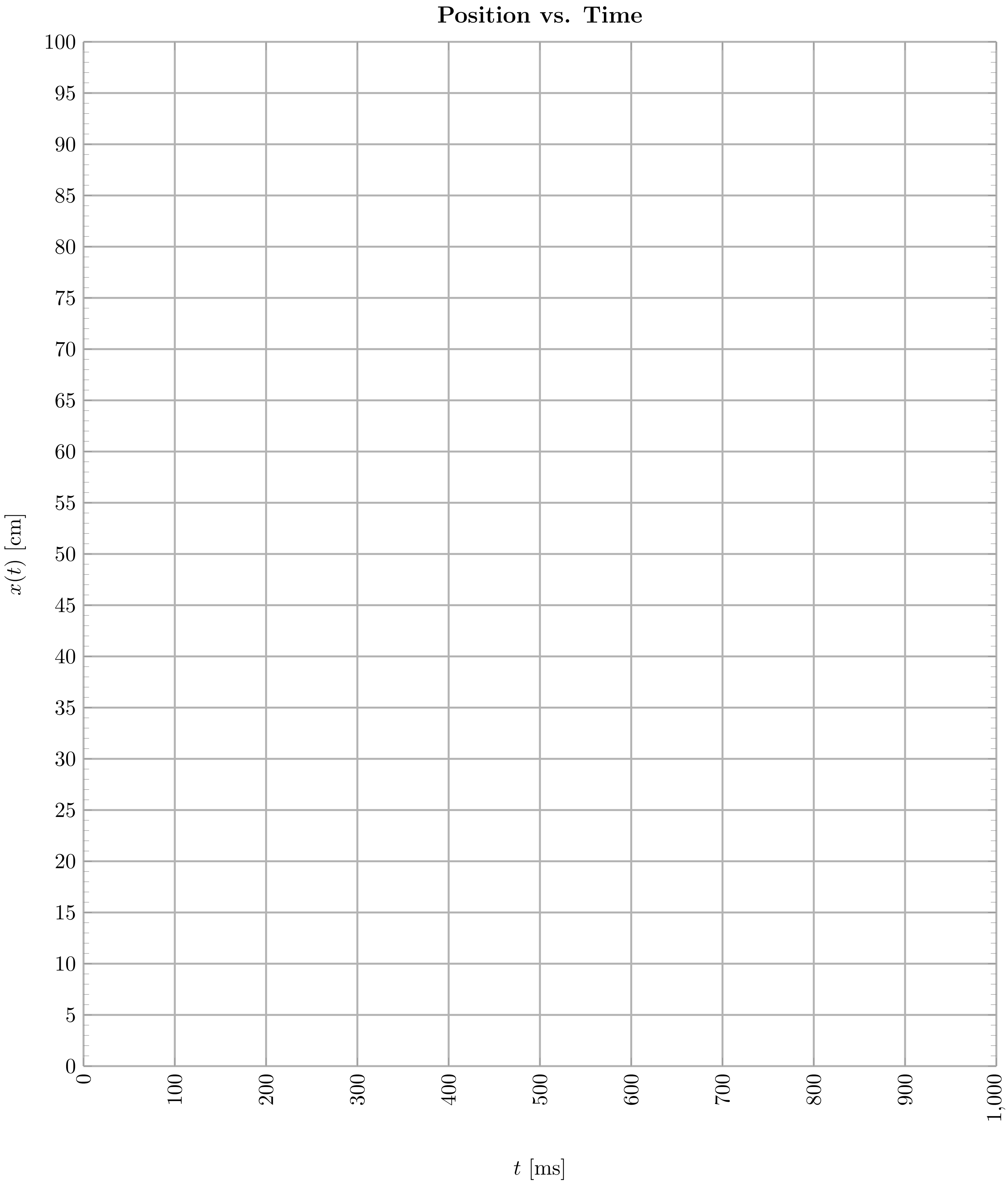
1. Set up the ticker device at the starting position of the inclined track. Ensure that the device is stable and ready for use.
2. Thread the white ticker tape through the two slits on the ticker device, making sure it passes beneath the circle of carbon paper. The carbon paper will produce the dots on the tape.
3. Attach one end of the ticker tape to the back of the car using a small piece of blue sticky tape. Make sure the tape is securely attached so that it follows the car's motion down the track.
4. Place the car at the top of the inclined track. Pull the ticker tape gently to ensure it is flat and unobstructed along the track.
5. Set the ticker device to **10 Hz** (10 clicks per second). The device should begin producing a steady clicking sound.
6. Release the car, allowing it to roll freely down the inclined track while the ticker device creates dots on the tape.
7. Turn off the ticker device after the car has reached the bottom of the track. Carefully detach the ticker tape and car.
8. Use two small pieces of blue sticky tape to secure the ticker tape to the table, ensuring it remains flat and does not roll back on itself.
9. Measure the position of each dot on the ticker tape using the meter stick. Record these positions to the nearest millimeter (or the nearest tenth of a centimeter). Ensure the closer-together dots are positioned on the left-hand side for easier measurement.
10. *TIP: Use the first dot after the cluster of overlapping dots—where the ticker device started—as your* $x = 0.0$ *cm reference point.*

Data

6. (2 points) Use the table below to fill in your data. Note that because every time is evenly spaced by 100 milliseconds (this is because of the ticker being set to 10 Hz), you can use $\Delta t = 100\,\text{ms}$ for every calculation of the velocities in the last column on the right hand side below.

Time (t) [ms]	**Position** (x) [cm]	**Displacement** (Δx) [cm]	**Velocity** ($v = \frac{\Delta x}{\Delta t}$) [cm/ms]
0	0.0	0.0	0.0
100			
200			
300			
400			
500			
600			
700			
800			
900			
1000			

7. (3 points) Use the space below to plot your position (x) vs time (t) data:



8. (2 points) Use the space below to plot your velocity (v) vs time (t) data: