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7 Ce
10/5

Velocity and Acceleration Lab:

Purpose: The purpose of this laboratory exercise is to conduct an experiment to determine velocities of a ball rolling down an inclined tube. We will be demonstrating what we have discussed in class and practicing calculations for velocity.

Pre Lab:

1) What are the SI units of time, distance, speed, and acceleration?

The units for time is seconds, the unit for distance is meters, the units for speed is m/s, and the units for acceleration is m/s^2.

2) What are the equations for speed and acceleration?

The equation for speed is $\frac{distance}{time}$, and the equation for acceleration is $\frac{\triangle v}{t}$ where v is velocity and t is the time.

3) What is the initial velocity of a ball that rolls down an elevated tube but begins at rest?

The initial velocity is 0m/s because the ball begins at rest, and rest means no movement.

4) What 2 measurements do I need to know to calculate the ball's velocity?

You need to know the displacement and time elapsed of the ball rolling down the tube.

5) If the ball is only moving in one direction, do I need to indicate a direction on every measurement?

No, because the final direction is the same as the initial direction. If the ball is moving one direction, then there is only a positive and a negative velocity, so you only need to indicate it on the last measurement to tell if it's going backward or forward.

6) A ball is timed to travel 4m in 5.2s. What is its speed? Velocity?

The speed is 0.77m/s. The velocity is also 0.77m/s because the direction is positive.

7) Assuming the ball begins at rest, what is the acceleration of a ball that has a final velocity of 1.42m/s after 4.67s? In what direction is the acceleration?

The acceleration is $0.3 m/s^2$. Since we are working on a 1-D scale, there is only a positive and negative direction. The acceleration is positive, so the ball is moving forward and getting faster.

Procedure:

1. Place your ramp on the ground with the groove facing up. One end on the floor, the other end is elevated by 3 textbooks.
2. Choose roles for team members. Four team members will be timers, one will set the ball rolling, and one will catch the call as it rolls off the ramp (If you don't have a 6th member, set up your ramp near a wall so the ball hits the wall after is has completed the trip down the ramp.
3. Each timer should be holding a stopwatch. Practice using stopwatches before beginning.
4. Mark even intervals down the ramp with small pieces of masking tape. Measure the length of these intervals. It will be easy to use the round holes on the ramp as interval markers.
5. Station 1 timer at each of the marked intervals.
6. The "roller" places the ball on the end of the tube and says GO exactly when the ball is released, signalling all timers to begin their stopwatches. Each timer should stop their stopwatches at the exact moment they see the ball pass their hole. The catcher picks up the ball immediately after it exits the tube.
7. Record the data for position vs. time. Fill in Table 1 in the data section as you work. Conduct 3 trials and find the average time for each segment.Once done collecting the position vs. time data, fill in the table to calculate the average velocity and average acceleration for each segment.

Data:

Time Data:

Interval:	Time-Trial 1 (s)	Time-Trial 2 (s)	Time-Trial 3 (s)	Time Average (s)
Start to 1st	0.63s	0.63s	0.63s	0.63s
1st to 2nd	0.65s	0.55s	0.65s	0.62s
2nd to 3rd	0.40s	0.47s	0.37s	0.41s
3rd to End	0.22s	0.25s	0.34s	0.27s

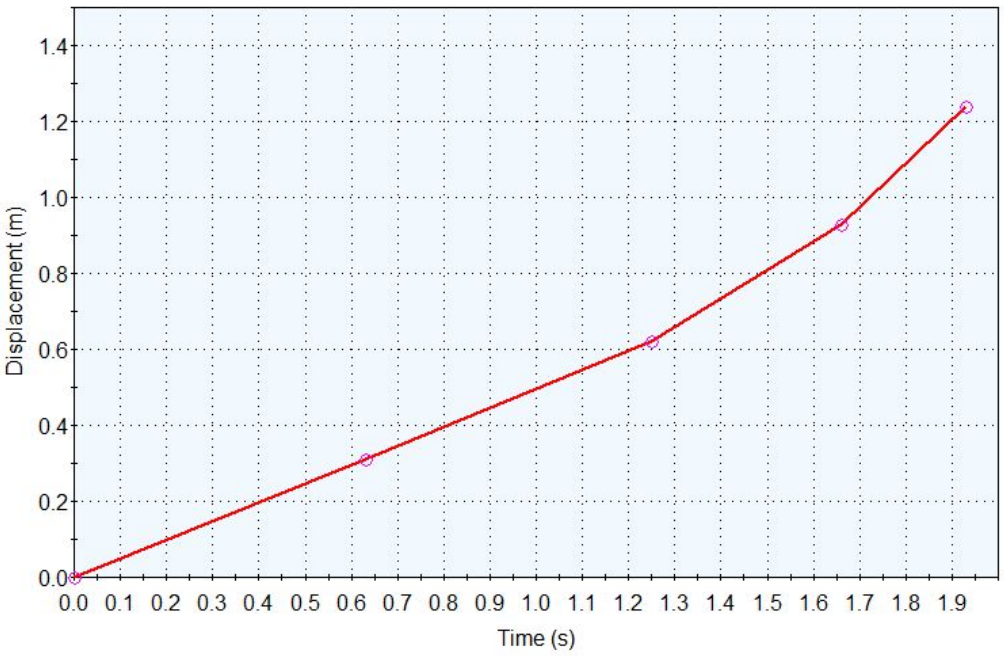
Velocity Data:

Interval:	Displacement (m)	Average Time (s)	Average Velocity (m/s)
Start to 1st	0.31m	0.63s	0.49m/s
1st to 2nd	0.31m	0.62s	0.50m/s
2nd to 3rd	0.31m	0.41s	0.76m/s
3rd to End	0.31m	0.27s	1.15m/s
Start to End	1.24m	1.93s	0.64m/s

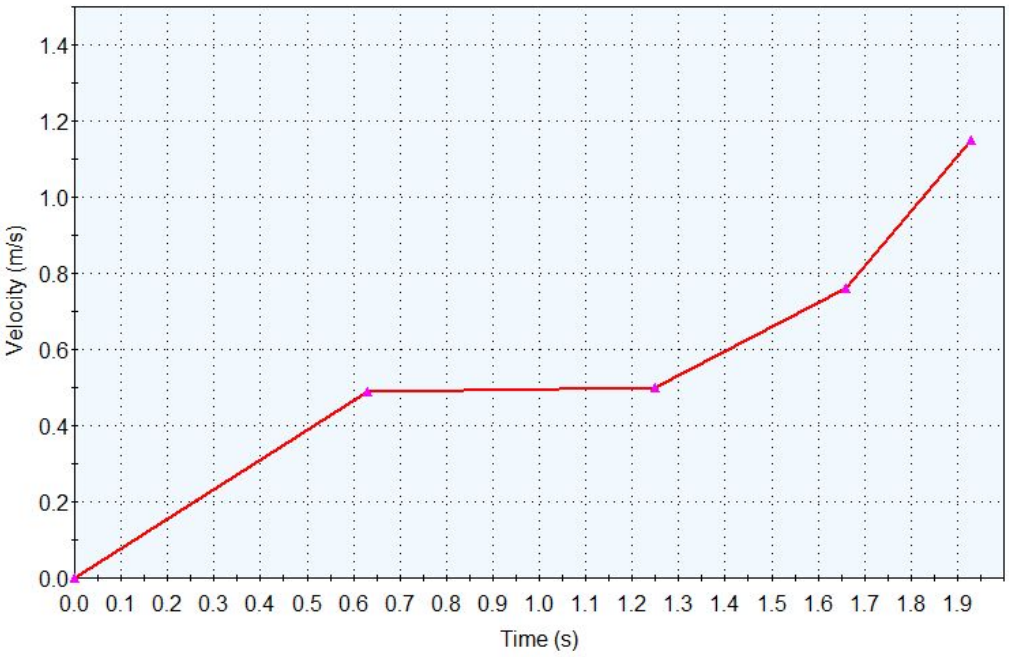
Acceleration Data:

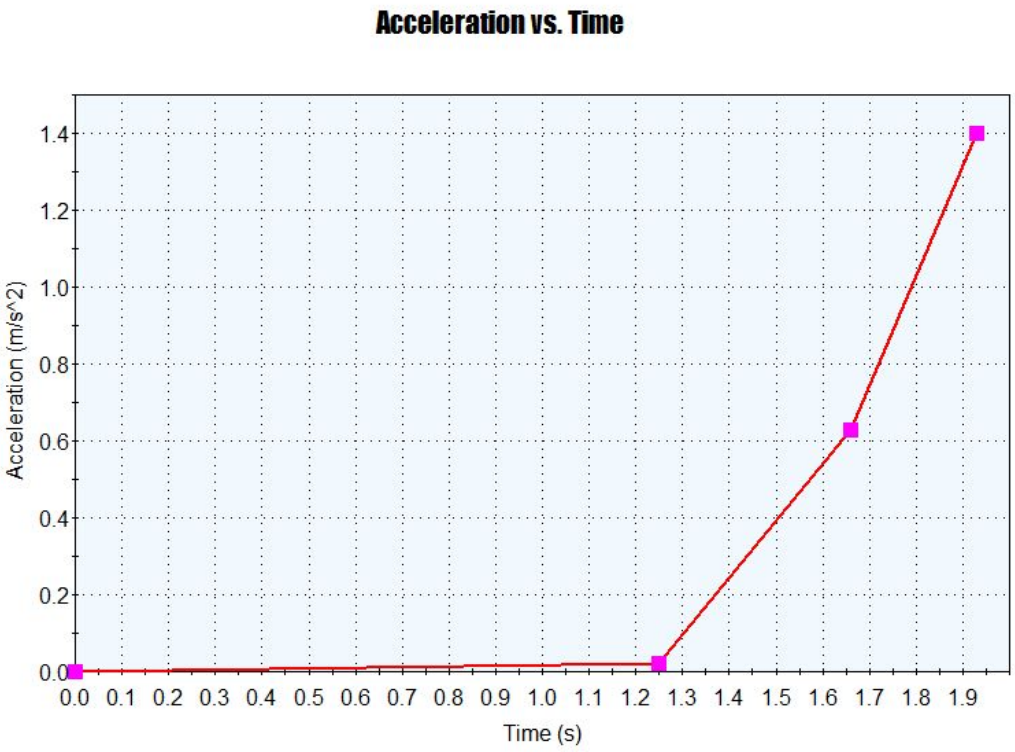
Interval:	Initial Velocity (m/s)	Final Velocity (m/s)	Change in Velocity (m/s)	Average Time (s)	Acceleration
1st to 2nd	0.49m/s	0.50m/s	0.01m/s	0.62s	$0.02 m/s^2$
2nd to 3rd	0.50m/s	0.76m/s	0.26m/s	0.41s	$0.63 m/s^2$
3rd to End	0.76m/s	1.15m/s	0.39m/s	0.27s	$1.40 m/s^2$
Start to End	0m/s	1.15m/s	0.64m/s	1.93s	$0.33 m/s^2$

Position vs. Time Graph



Average Velocity vs. Time Graph





Analysis:

1) Which of the 2 equations did you learn in unit 2 were needed to complete this laboratory assignment? Write out the full equations.

We used the equations velocity=$\frac{total\ displacement}{time\ elapsed}$, and acceleration=$\frac{change\ in\ velocity}{time\ elapsed}$.

2) Why did we choose to use 0m/s as our initial velocity?

We chose 0m/s because when the ball is at the top of the ramp, it starts at rest then accelerates to other velocities.

3) Which average velocity was greater, the average velocity for "start to 1st" or the average velocity for "3rd to end"? What does this tell you about what was happening to the ball as it rolled down the tube?

The "3rd to end" velocity was larger than the "start to 1st" velocity. This tells us that the ball accelerated or got faster as it went down the ramp.

4) Was your hypothesis correct? Why or why not?

My hypothesis was correct because I thought that the ball was going to accelerate or speed up as it goes down the ramp. This was proved correct by the experiment.

5) We calculated a change in velocity by subtracting average velocities in each segment. What possible errors could this have introduced in our acceleration equations?

The ball could have ended and started in a different velocity than the average velocity. The ball couldn't have been at a constant velocity the whole time it traveled from one mark to the next.

6) What other possible errors could have affected this experiment?

The timers might have been stopped a little late, and the ramp was moved a little during the middle of the experiment. This would affect the slant height of the ramp.

7) What could you do differently next time to reduce error or make the experiment easier?

We could have electronic sensors every time the ball passed the hole. We can also make sure the ramp doesn't move by taping the start end down.

8) How could you have changed this experiment to increase or decrease the acceleration?

I could have made the ramp higher, shorter, longer, or shorter. Also, I could have made a different sized ball to roll down the ramp.

Conclusion:

This experiment showed how acceleration can be affected by the independent variables. This also shows that the acceleration is not always constant. Later, we will have to deal with non-constant accelerations. The ball had a smooth surface, while other objects may have a rougher and bumpier surface. These are only a few factors of what can affect acceleration and velocity.