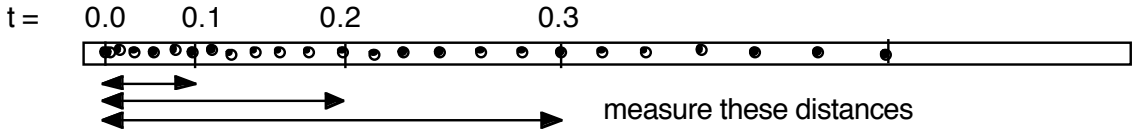
Lab 2-2: **Toy Car**

Purpose: 1. To analyze the motion of a toy car speeding up and slowing down across the floor by making the following graphs: position vs. time, average velocity vs. time, and average acceleration vs. time.
2. To define the following terms: acceleration, average acceleration, constant acceleration

Discussion: In the previous lab, we looked at the motion of someone traveling with a constant speed, and of a car speeding up. This lab extends those ideas by analyzing the motion of something speeding up, then slowing down, and finally coming to rest.

Materials:
l toy car
l dot machine w/carbon paper circle
~1.5 meters of ticker tape
1 piece of masking tape

Procedure:
1. Attach the ticker tape to the roof of the car.
2. Pull the car back to wind up the spring; pull any loose ticker tape paper back through the dot machine so that there is no slack in the tape. Your objective is to let the car go and have the tape still in the dot machine when the car has stopped.
3. Turn on the dot machine and release the car. Make sure the dot machine does not move. Release the car. Shut the machine off when the car has stopped. If the car went so far that the tape came through the machine, repeat the experiment but don't wind the car up as much. Make sure you can see dots (or at least the impressions of the dots) on the whole tape!
4. Remove the strip from the car and mark it as follows: Starting from the clearest individual dot at the start of the tape, put a line through every 6th dot on the strip. This will represent a time interval of 0.1 seconds, since the dot machine hits the paper 60 times each second. Do this for the whole trip.
5. Measure the distance from the first line (time = 0) to each interval. Record your data in the table below. If you need more room, make extra columns somewhere.



Data:

time (s)	position (cm)
0.0	0.0
0.1	
0.2	
0.3	
0.4	
0.5	
0.6	
0.7	
0.8	
0.9	

time (s)	position (cm)
1.0	
1.1	
1.2	
1.3	
1.4	
1.5	
1.6	
1.7	
1.8	
1.9	

time (s)	position (cm)
2.0	
2.1	
2.2	
2.3	
2.4	
2.5	
2.6	
2.7	
2.8	
2.9	

Graph: Use Graphical Analysis to make the following graphs: Position vs. Time and Average Velocity vs. Time. Be sure to put a title on each graph and label the axis and its units. On the velocity graph, put in two regression lines, one showing the speeding up portion and the other showing the slowing down. After printing the graphs, use a pen or pencil to sketch the best curves that fit the data. (Sections may be straight.)

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Conclusion:

1. For the graph of Position vs. Time:
   a. On the graph, mark the regions that show the car speeding up and then slowing down.

   b. What happens to the slope of this curve and how does it relate to the velocity of the car? (Consider both magnitude and direction.)

   c. What does the concavity of the d vs. t graph tell you about the velocity of the car?

2. For the graph of Average Velocity vs. Time:
   a. On the graph, mark the regions that show the car speeding up and then slowing down.

   b. What does the slope of the velocity vs time graph tell you?

3. What were the average accelerations of the car:
   a. while speeding up?

   b. while slowing down?

   c. How did you determine those numbers?

4. Is it possible to have a negative acceleration, yet still be moving forward? Explain.

5. The velocity of the car was changing, but always positive. Would our lab setup have worked if the car had a negative velocity at some point? Explain.

6. What is the difference between velocity and speed?