SAN DIEGO MESA COLLEGE
PHYSICS 100 LAB REPORT

TITLE: **Uniform Motion**

Name_____

Date _____Time_____

Partners _____

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Objective: To determine the equation of motion for a toy tractor.

Theory: The motion of an object is described by the change of it's position with respect to time, as measured from a start point for it's position and it's time (i.e. at x=0 and t=0). The mathematical relationship for an object's position as a function of the time it reaches that position is called the object's equation of motion. The simplest equation of motion is for motion without acceleration. This motion is called uniform motion.

Equipment: motorized cart   tape timer mount
                  tape-timers   1 1/2 meter strips
                  meter-stick   brick
                  masking tape

Setup:
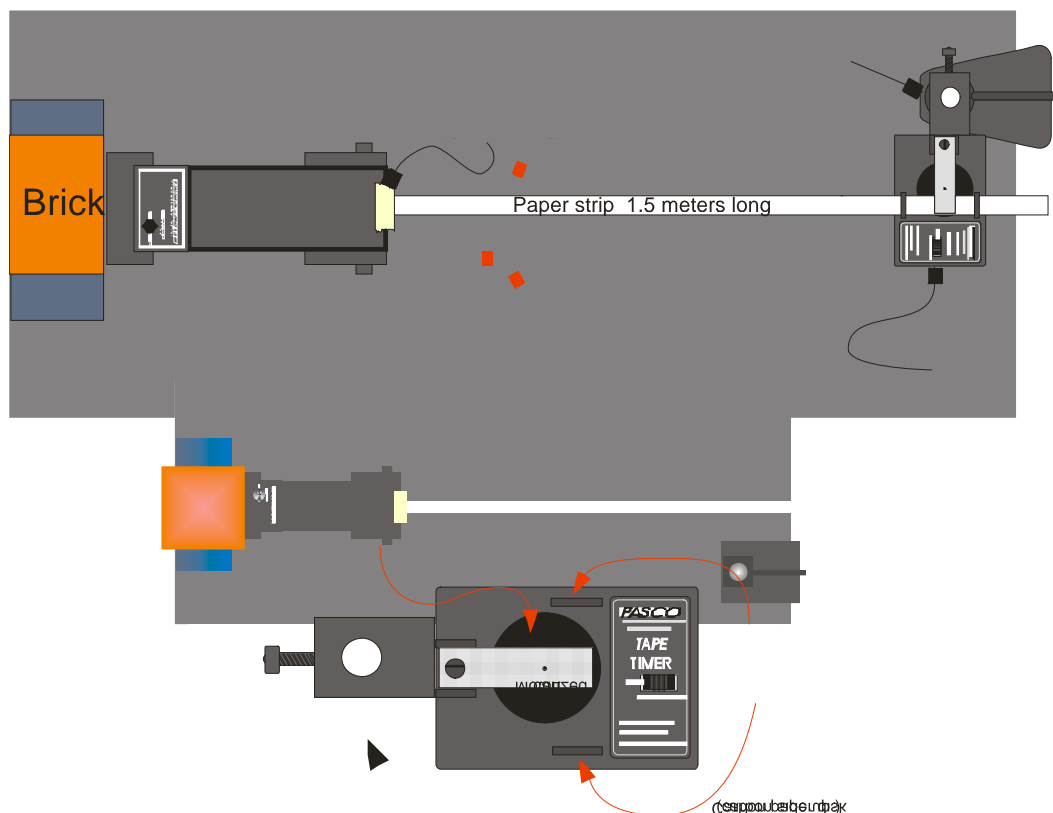
Technique: The tape timer has a circular piece of carbon paper and a tapping mechanism. The tapper taps on the carbon paper specific number of times per second. As the toy tractor moves, the tape timer puts marks on the paper strip at regular time intervals. The amount of time between marks (the Δt) is decided by which direction the switch on the timer is moved when it is turned on. There are two settings 10Hz and 40Hz. We will be using the 10Hz setting for a $\Delta t = 0.1$seconds. The tractor will move a certain distance Δx between each mark. These two sets of values will give us the data we need to get the equation of motion.

Procedure: Turn the tractor on temporarily to see which direction it will move.
Face it so it will move away from the tape timer.
Get one of the long paper strips.
Feed one end through the first plastic slot, then in between the silver metal plate and the circular piece of carbon paper, and out through the other plastic slot. If it's not feeding easily, slightly bend a small portion of the end of the paper strip. This might help.
Take a small piece of masking tape and tape the end of the paper strip nearest to the timer to the top of the tractor.
 Place the tractor near the tape timer, but leave enough room to lift the tractor off the table a little bit (you'll lift it later).
Pull the rest of the tape out the back of the tape timer so that it is hanging over the edge of the table.
Have one partner lift the tractor off the table enough so that they can turn the tractor on.
Have another partner on the opposite end of the table ready to stop the tractor.
Have a third partner move the switch on the tape timer to the 10Hz position. The timer should start clicking.
Have the person with the tractor turn it on, aim it towards the brick and set it on the table.
Once the tractor gets to the other side of the table, move the timer's switch to the off position to turn it off.
Remove the paper strip from the tractor and turn it over. Make sure the marks made by the timer are dark and visible.
 If they are easily visible, then you are ready to start the analysis. If not, try rotating the circular piece of carbon paper and run through the procedure again. If this still doesn't produce visible marks, ask the instructor for help.

Analysis: Look at the marks (dots) on your strip.
The beginning of your strip is the side that was attached to the tractor. The first few marks probably won't look evenly spaced.
Choose and circle the first dot, after skipping several, which appears sharp and is evenly spaced with its neighbors. This is dot #1 which occurs at $t = 0$ sec. and has a starting position of $x = 0$ cm.
Lay the paper strip along a meter stick or ruler and use masking tape to attach the first dot you choose for $t = 0$ and $x = 0$ to the zero end of your meter stick or ruler.

Record the position of where each dot is along the ruler or meter stick.
Calculate the distance interval between each dot and the dot before it. The distance
interval is the position of each dot minus the position of the dot before it. The distance
interval is also known as Δx.

Dot #	Position (cm)	Time (Ticks)	Distance Interval (cm)	Ave.Velocity In interval (cm/sec)
1	0.0	0		
2		1		
3		2		
4		3		
5		4		
6		5		
7		6		
8		7		
9		8		
10		9		

The average velocity that the object obtains during an interval of one tick is the distance
interval traveled during that one tick divided by the time elapsed (one tick). To
calculate the average velocity, divide the distance interval by one tick.
This gives you units of cm / tick.
To convert this to a usable number, you will need to multiply this number by the
Number of ticks per 1 second.
There are 10 ticks per second.
This will give you units of cm / sec.

 Fill in your table with each of the average velocities.

Because the motion is uniform, the average velocity over all the intervals can be found by adding up all the average velocities, and dividing by the total number of average velocities intervals.

Record this value below the average velocity column on the data sheet.

Analysis: The equation of motion is found by plotting the distance (in cm, on the y-axis) as a function of time (in ticks, on the x-axis).
Plot this on the linear graph paper provided in your lab packet.

Calculate the slope of your graph, showing all work including units, in the space provided below.

$(D_{final} - D_{initial}) / (T_{final} - T_{initial}) = slope$

Where D is distance in cm and T is the time in ticks

Convert this slope to cm / second using the same conversion as you did for the average velocity.

SLOPE FROM GRAPH: CONVERSION:

Calculate the percent difference, in the space provided below, between the average velocity from the data sheet and the slope of the graph, using the formula:

% difference = (difference between two experimental values / the larger of two values) x 100

What name is given to the constant (the slope of the graph) which relates the distance traveled by the tractor and the time it took to get to that distance?

Write the equation of the graph, in the form y = mx + b. in the space below. Where y is the variable plotted on the vertical axis and x is the variable plotted on the horizontal axis, m is the slope of the graph, and b is the vertical intercept. The vertical intercept, b, will be close enough to zero to be neglected.

Don't forget to include units in your equation.

Use this equation to calculate, showing all work including units in the space provided below, how far the tractor would travel in 45 seconds.

How many meters is this? Show your work in converting the units.

How many yards is this? Show your work in converting the units.

Analysis:

Use this equation of motion to predict how many MINUTES it would take the tractor to Travel 11.78m which is the length of the lab room.

Show all your work below including unit conversions.

Summary of Results: (What is the equation of motion for the tractor, in words)?