Name:
Date:
Science p. ___
Teacher:

Measuring Changes in Motion: Speed, Velocity, and Acceleration

Testable Question: How does the motion of a rolling ball change on a flat surface?

Prediction (Circle one)**:** *The speed of a ball rolling on a flat surface gets* ***faster / slower.***

Hypothesis (Circle one for each variable)**:** If the distance from the bottom of the ramp **increases / decreases**, then the speed of the ball will **increase / decrease**.

Materials

books 1 ball 1 ramp/ruler 2 stop watches 1 meter stick Tape

Directions

1. Using the meter stick, measure <u>one</u> meter from the wall and mark it with your first piece of tape (Label this "A"). Then measure <u>two</u> meters from the wall (*or 1 meter from your first piece of tape*) and mark it with your second piece of tape. See set-up below. Use your third piece of tape to secure one end of the meter stick at the 2 meter mark. Note: The WALL is the end of "Distance B".

2. Place books under the ramp so that a secure incline is created. (The ramp should slope down <u>toward</u> the wall with the end of the ramp placed <u>two</u> meters from the wall.)

3. Carefully, put the ball at the top of the ramp.

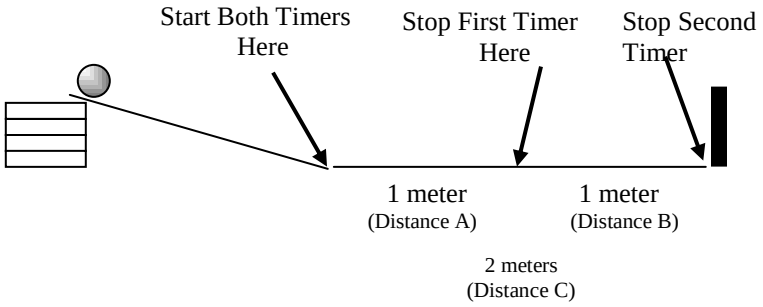
4. Practice rolling the ball down the ramp and <u>timing from the bottom of the ramp</u>. Adjust height of ramp to ensure the ball reaches the wall. Have the same 2 people serve as the "timers" throughout the entire investigation. Both must <u>start</u> the stopwatches at the <u>same time.</u>

5. Begin the trial by letting the ball roll down the ramp and <u>time</u> how long it takes to travel:
   - One person times from the <u>bottom</u> of the ramp to the **1 meter mark** (Distance A Time)
   - One person times from the <u>bottom</u> of the ramp to the **wall**. (Distance C Time)

6. Record times in seconds in the data table and then clear all timers. (i.e. $0{:}01_{13}$ = 1.13 sec.)

7. Repeat steps 5 to 6 for three trials. Return your materials to their appropriate spots at the end of the investigation.

Ramp set-up:



Observations/Data Tables

		Distance of Roll		
Time for Ball to Roll in Seconds	**Trials**	**Distance A Time to Travel 1 Meter**	**Distance B Time to Travel 1 Meter**	**Distance C Time to Travel 2 Meters**
	1			
	2			
	3			
	Average Time			

HINT
(Distance C Time)
− (Distance A Time)
(Distance B Time)

Speed: Average Speed = $\frac{D}{T}$ = $\frac{\text{Distance}}{\text{Average Time}}$ = (Also written as Distance ÷ Time)

	Distance A (First Meter)	**Distance B (Second Meter)**	**Distance C (Total Distance)**
Speed **S = $\frac{D}{T}$**	S = $\frac{D}{T}$ S = $\frac{1 \text{ meter}}{\square}$ S =		

Graph (T.A.I.L.S)

Distance from Ramp vs. Speed

(____ axis)

Speed
(m/sec)

You will need to decide on a range

(____ axis)

First Meter
(Distance A)

Second Meter
(Distance B)

Total Distance (#4 below)
(Distance C)

Name:

Date:
Science p. ___
Teacher:

Conclusion: Summary Questions for Measuring Changes in Motion Investigation

Directions: Write your answers on the lines under the question.

1. What two pieces of data do you need to know in order to state the velocity of any of the balls?

   _____ and _____

2. Describe what happened to the time it took the ball to roll an *equal* distance as it moved farther from the ramp.

   _____

   _____

3. Did the speeds in this investigation remain constant or change? Use data to support your answer.

   _____

   _____

   _____

   _____

   _____

4. Your teacher states that the ball accelerated as it rolled from the bottom of the ramp toward the wall. Explain why your teacher is correct.

   _____

   _____

   _____

   _____

5. Explain how the velocity of a moving object could change even if the speed does not.

   _____

6. How do you think changes in the motion of the ball and gravity are related?

   _____

   _____

   _____

Summary Calculations for Measuring Changes in Motion Investigation

Directions: Show all calculations for the questions below. Be sure to label your answers.

The formula for speed is: $\frac{D}{T} = \frac{\text{Distance}}{\text{Average Time}}$ **(Also written as Distance ÷ Time)**

1. What is the speed of the ball for distance A (the first meter)?

2. What is the speed of the ball for distance B (the second meter)?

3. What is the average speed for the ball as it travels distance C (the total distance)?

4. Label and graph the speed for distance C.

5. What do you notice about speed C in comparison to speed A and B?

The formula for acceleration is: $\frac{\text{Final velocity – Original velocity}}{\text{Time of change}}$

6. If the original velocity of the ball at the bottom of the ramp was 0.8 m/s, and the final velocity of the ball was 0.5 m/s, what was the ball's acceleration if it took 2.5 seconds to travel the two meters?

7. If the original velocity of the ball at the top of the ramp was 0 m/s and the final velocity of the ball at the bottom of the ramp was 0.9 m/s, what was the ball's acceleration if it took 0.45 seconds to travel down the ramp?