Name _____ Date _____ Class _____

Motion · *Skills Lab*

Inclined to Roll

Problem

How does the steepness of a ramp affect how fast an object moves across the floor?

Skills Focus

measuring, calculating, graphing

Materials

skateboard   meter stick   flat board, about 1.5 m long

protractor   masking tape   small piece of sturdy cardboard

supports to prop up the board (books, boxes)

2 stopwatches

Procedure   *Review the safety guidelines in Appendix A.*

1. You will record your results in the data table on the next page.
2. Lay the board flat on the floor. Using masking tape, mark a starting line in the middle of the board. Mark a finish line on the floor 1.5 m beyond one end of the board. Place a barrier after the finish line.
3. Prop up the other end of the board to make a slight incline. Use a protractor to measure the angle that the board makes with the ground. Record the angle in your data table.
4. Working in groups of three, have one person hold the skateboard so that its front wheels are even with the starting line. As the holder releases the skateboard, the other two students should start their stopwatches.
5. One timer should stop his or her stopwatch when the front wheels of the skateboard reach the end of the incline.
6. The second timer should stop his or her stopwatch when the front wheels reach the finish line. Record the times to the bottom of the ramp and to the finish line in the columns labeled Time 1 and Time 2.
7. Repeat Steps 4–6 two more times. If your results for the three times aren't within 0.2 seconds of one another, carry out more trials.
8. Repeat Steps 3–7 four more times, making the ramp gradually steeper each time.
9. For each angle of the incline, complete the following calculations and record them in your data table.
   a. Find the average time the skateboard takes to get to the bottom of the ramp (Time 1).
   b. Find the average time the skateboard takes to get to the finish line (Time 2).
   c. Subtract the average Time 1 from the average Time 2.

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Data Table

Complete the data table below.

Angle (degrees)	Trial Number	Time 1 (to bottom) (s)	Time 2 (to finish) (s)	Avg Time 1 (s)	Avg Time 2 (s)	Avg Time 2 – Avg Time 1 (s)	Avg Speed (m/s)
	1						
	2						
	3						
	1						
	2						
	3						
	1						
	2						
	3						
	1						
	2						
	3						
	1						
	2						
	3						

Analyze and Conclude

Write your answers in the space provided.

1. **Calculating** How can you find the average speed of the skateboard across the floor for each angle of incline? Determine the average speed for each angle and record it in your data table.

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Inclined to Roll *(continued)*

2. **Classifying** Which is your manipulated variable and which is your responding variable in this experiment? Explain. (For a discussion of manipulated and responding variables, see the Skills Handbook.)

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3. **Graphing** On a graph, plot the speed of the skateboard (on the *y*-axis) against the angle of the ramp (on the *x*-axis). Connect the points on your graph. Use the space below to make your graph.

4. **Drawing Conclusions** What does the shape of your graph show about the relationship between the skateboard's speed and the angle of the ramp?

   _____

   _____

5. **Measuring** If your measurements for distance, time, or angle were inaccurate, how would your results have been affected?

   _____

   _____

6. **Communicating** Do you think your method of timing was accurate? Did the timers start and stop their stopwatches exactly at the appropriate points? How could the accuracy of the timing be improved? Write a brief procedure for your method.

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   _____

   _____

   _____

Design an Experiment

A truck driver transporting new cars needs to roll the cars off the truck. You offer to design a ramp to help with the task. What measurements might you make that would be useful? Design an experiment to test your ideas. *Obtain your teacher's permission before carrying out your investigation.*