Name **Section #**

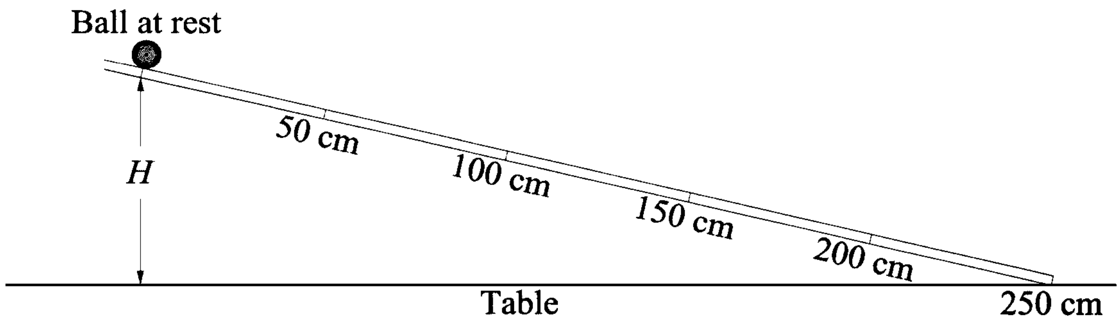
Measuring Acceleration Down An Inclined Plane

Purpose

To determine the acceleration of a ball down an inclined plane and to find a relationship between the acceleration and the angle of the plane.

Procedure

Set up the inclined plane as shown below by resting one end of the track on the adjustable desk clamp. Set the height, H to 10 cm. Using the masking tape supplied, mark off a starting point at the top of the end of the plane, and mark off the distance along the plane in units of 50 cm until you reach the bottom end.



Let the ball roll from rest and time it from the start to the 50 cm point. Do this three times and take the average of the three readings. Record this time t in Table 1 for the displacement $d = 50$ cm. Record the ball's average velocity $\bar{v} = \frac{d}{t}$ and its final velocity $v_f = 2\bar{v}$ in columns 3 and 4. Then time the ball from rest at the top to the 100 cm point three times, take the average value for the time and record this value together with $\bar{v}$ and v_f for the 100 cm displacement. Repeat again for 150 cm, 200 cm, and for 243 cm. Obtain data for Tables 2 and 3 by raising the height of the track to 20 cm, then to 30 cm, and repeating the procedure at the beginning of this paragraph.

Plot t as the abscissa and v_f as the ordinate for each of the Tables 1, 2, and 3. (Plot all three graphs on the same axes using different colors to distinguish between the data from each table.) Connect the points in each graph with a best-fit straight line and determine its slope. The slope represent the average acceleration $\bar{a}$ for a particular angle of inclination. You may obtain the angle θ corresponding to a particular height by dividing the height by the length of the track (which is probably 243 cm.) This will give you $\sin\theta$, take the arcsine of this value to get θ. Corresponding to each of the three heights in Table 4 enter the angle, its sine, and the average acceleration (i.e., the slope of the v—t graph).

Table 1: $H = 0.10$ m

d (m)	t (s)	$\bar{v}$ (m/s)	v_f (m/s)
0.50			
1.00			
1.50			
2.00			
2.43			

Table 2: $H = 0.20$ m

d (m)	t (s)	$\bar{v}$ (m/s)	v_f (m/s)
0.50			
1.00			
1.50			
2.00			
2.43			

Table 3: $H = 0.30$ m

d (m)	t (s)	$\bar{v}$ (m/s)	v_f (m/s)
0.50			
1.00			
1.50			
2.00			
2.43			

Table 4: Summary of Tables 1, 2, & 3

H (m)	$\sin\theta$	θ	$\bar{a}$ (m/s^2)
0.10			
0.20			
0.30			

Questions

- How does the velocity change at each check point (50 cm, 100 cm, 150 cm, 200 cm, and 243 cm) as the ball rolls down the hill? What causes the changes you observe?

- Does the acceleration change as the ball is allowed to roll longer distances down the plane? If there is such a change, what is its cause?

Graph of v_f versus t for Heights of 10 cm, 20 cm, and 30 cm

Graph of $\bar{a}$ versus $\sin\theta$

- Use Table 4 to plot the average acceleration (ordinate) versus $\sin\theta$ (abscissa). These should be proportional to each other. Make a best-fit line and determine its slope. Multiply the value of the slope by $7/5$ because the ball rolls rather than slides. What value do you obtain?