**Lab # 1**

**The Determination of “g” with a Linear Air Track**

**Purpose:** The purpose of this experiment is to measure the acceleration due to gravity.

**Procedure:** The linear air track consists of a triangular, hollow aluminum track with four rows of holes on the sides through which air is forced at a uniform rate by a blower. There are 150 holes per meter; each hole with a diameter of 0.5 mm. Gliders are inverted “vees” that fit on top of the track. The air escaping from the holes in the track lift the glider approximately 0.3 mm above the track surface, separating the glider from the track by a thin layer of air. As the glider moves along the track, the lift remains the same, because at any given instant, the number of holes below the glider is constant.

The frictional resistance offered by the layer of air is so small that it can be neglected. Therefore, the linear air track is a useful device to demonstrate many fundamental concepts in mechanics.

Since the glider motion is very sensitive to track slope, it is first necessary to level the track by adjusting the only single leg screw until a glider has minimum drift over the length of the track.

Using a ruler measure the spacer (thickness h) and then place it under the single leg end of the track (see Figure 1)



The acceleration of the glider along the track is a constant and given by:

$$a=gsinθ$$

where g is the acceleration due to gravity and θ is the angle of the track slope. Since θ is very small it can be approximated by:

$$sinθ≈θ≈h/L$$

where L is the separation distance between the supporting posts and h is the thickness of the spacer.

$$∴a=gh/L$$

If t is the time required for the glider to move a distance, d, from rest, then from the basic equation of motion

$t^{2}=\frac{2d}{a}≈\frac{2dL}{gh}$ (Equation 1)

To ensure that the glider always starts from rest, place the glider so that the fin triggers the first timing gate immediately upon release of the glider. This should be established close to the highest end of the track. From the center of the upper timing gate measure a distance of 1.0 m down the track and locate the second timing gate at this position. The interruption of the photoelectric eye of the lower timing gate by the glider fin will automatically stop the time, and give a precise value of t.

Measure h, if you haven’t already done so, and L. Note L is the length between the legs of the air track not the overall length of the track. Release the glider from rest, and record the time for the glider to traverse this distance. Repeat 3 (or more times) times looking for consistent results. Repeat the entire procedure for the five distances (values of d) ranging from 1.0 m down to 0.2 m by moving the lower timing gate towards the upper one. Note the time for each measurement, and for each of d calculate the mean value of t and it’s square t2. Tabulate this data including error on all distance measurements.

**Analysis:** Plot a graph of t2 versus d. According to equation 1 it should be straight line with a slope of $\frac{2L}{gh}$. Determine the slope of the line on your graph and use your measured values of h and L to determine g. Compare g with the accepted value of 9.80 m/s2 by finding the percentage error.

How would you account for any significant difference between your value and the accepted? How does the slope of the graph compare with the expected slope of $\frac{2L}{gh}$? Why is using a linear air track better for determining g then other conventional methods of timing falling objects or rolling balls down a slope?