Experiment No: M3

Experiment Name: *“Motion with Constant Acceleration in Inclined Plane”*

Objective:

-Experimentally examining motion with constant acceleration in one dimension and on an inclined plane.

- Calculation and compare of the experimental acceleration a_{Exp} and theoretical acceleration $a_{Theo.}$

Keywords:

Constant acceleration, Inclined Plane, slope, time, distance

Theoretical Information :

Inclined planes are called surfaces that stand at a certain angle θ with the horizontal. Figure 1 shows an object with mass m_1 placed on an inclined plane and the forces acting on this object.

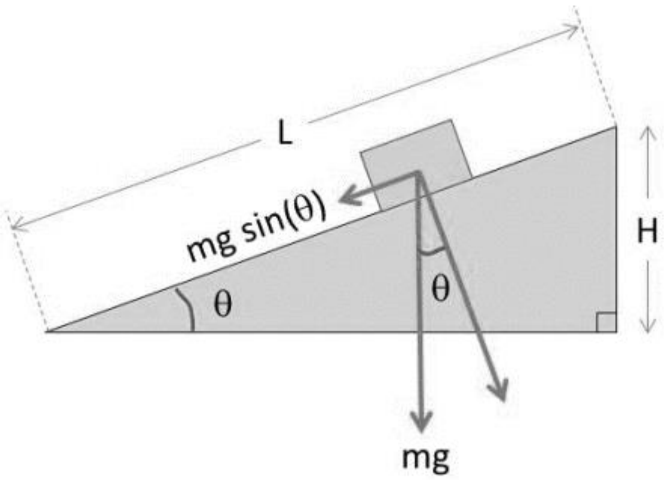

Figure 1. Diagram of a mass m on an inclined plane. The tangential component of the force of gravity accelerates the mass down the incline and is equal to $mgsin(\theta)$.

Assuming the inclined plane is frictionless, more than one force acting on an object of mass m_1 will be as shown in Figure 1.

All objects near the earth have a uniform downward acceleration due to gravity. By tilting the air track by a small amount, you effectively “reduce” the acceleration due to gravity. This idea was first employed by Galileo, who used an inclined plane rather than tilted air track.

Suppose **g** is the (downward) acceleration due to gravity. When an object of mass m is placed on an inclined plane, the downward force mg on the object due to gravity may be resolved into two components (see Figure 1). One component is normal (perpendicular) to the plane, and one is tangent to (along) the plane. The component of the force of gravity that is normal to the plane is balanced by the reaction force of the plane on the object (in this case the force provided by the air blowing out of the holes in the air track). Thus, the total normal force on the object is zero.

From Figure 1, if the length of the airway (inclined plane) is L and the height of the upper end is H, $\sin(\theta\ )$ is found by the following equation.

$$\sin(\theta) = \frac{H}{L} \tag{1}$$

The air track produces no tangential force on the object and the net tangential force on the object is just that due to gravity. Figure 1 shows that the tangential component of the force on the object is

$$F = m_1 g \sin(\theta) \tag{2}$$

According to Newton's law of motion, the acceleration a (here the tangential acceleration) is related to the tangential force by the equation

$$F = m_1 a \tag{3}$$

Using Equation 2 and Equation 3, the equation giving the relationship between acceleration a and angle θ is found.

$$a = g \sin(\theta\ ) \tag{4}$$

If the acceleration expression is integrated with respect to time,

For velocity;

$$v = g\ t \sin(\theta\ ) \tag{5}$$

For distance;

$$x = \frac{1}{2}\ g\ t^2\ \sin(\theta\ ) \tag{6}$$

In the above equations, it is assumed that the motion starts from the starting point without initial velocity ($v_0 = 0$).