(M1-6) Inertial Mass

Aim of experiment

In collision experiment, the ratio of mass velocities is constant

Apparatus

Air track- 2 photogates- 2 gliders- springs with different spring constant- Speed Meter/Timer- masses stopper arm

Theory of experiment

Air Track consists of a hollow extruded aluminum beam with small holes drilled into the upper surface. Compressed air is pumped into the beam and released through the holes. This forms a cushion of air supporting a glider on a nearly frictionless surface. The glider can move with almost frictionless horizontal motion

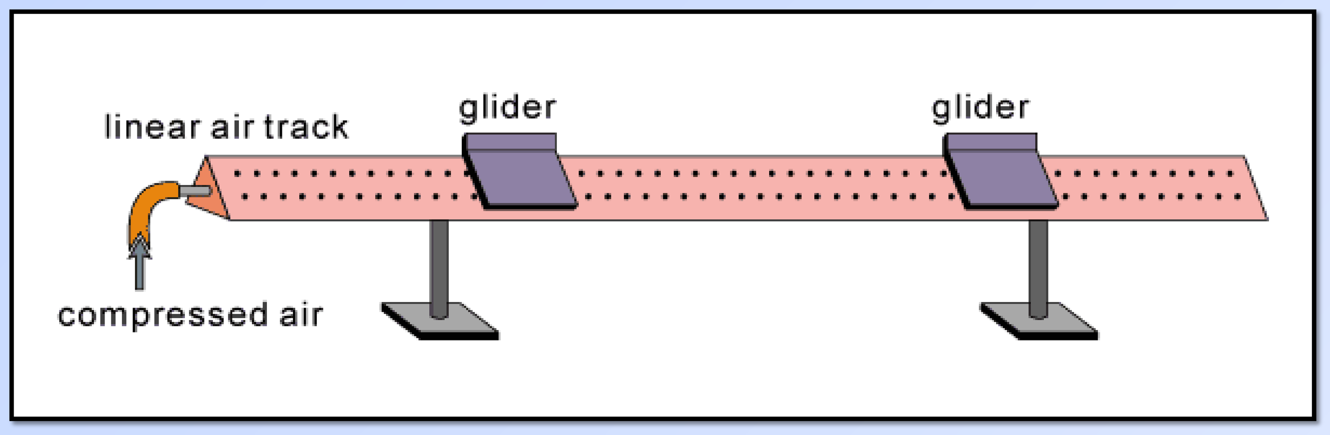


Figure 1. Baic Air Track device

In what follow, we compare the law of universal gravitation with Newton's second law of motion. The mass that appears in the law of universal gravitation is the property of the particle that creates the gravitational force acting on the other particle; for if we double m_2, we double the force on m_1.

Similarly, the mass in the law of universal gravitation is the property of the particle that responds to the gravitational force created by the other particle. Newton's second law of motion, ***F=ma***, describes how any force, gravitational or not, changes the motion of an object. For a given force, a large mass responds with a small acceleration and vice versa. The second law provides a definition of inertial mass as the property of matter that resists changes in motion or, equivalently, as an object's inertia.

From both the law of universal gravitational and Newton's second law, one can proof that both inertial mass, $m_{inertial}$ and the gravitational mass $m_{gravitationa}$ are equal.

$$m_{gravitational} = m_{inertial}$$

And there is no need to distinguish between the two definitions. The value of an object's mass is unique, independent of its method of measurement.

If one applies the same force to two masses, m_1 and m_2, both masses moves with velocities, such that the ratio between them is constant, that is

$$\frac{v_1}{v_2} = constant$$

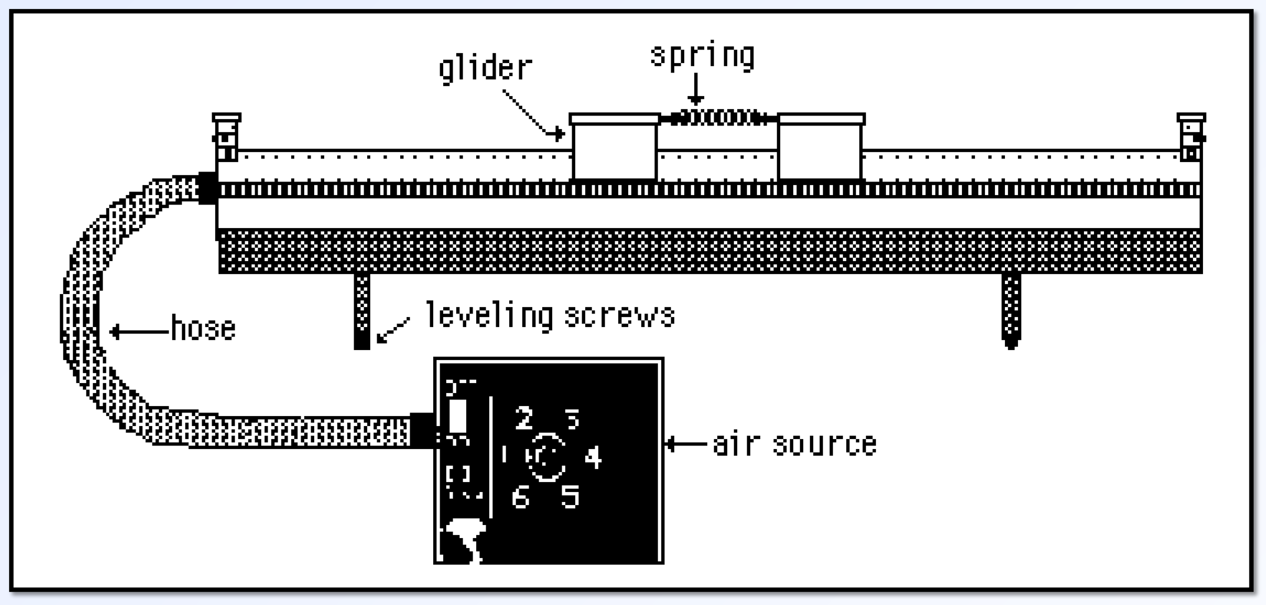
And this constant is given by $\frac{m_2}{m_1}$

Then
$$\frac{v_1}{v_2} = \frac{m_2}{m_1}$$

In the present experiment if we know a mass we can determine another mass if we can measure their velocities, if same force applied to both masses.

Procedure

1. Turn on the air supply and increase the flow volume until the gliders are floating on a cushion of air. Level the air track by placing a glider in the center of the track and adjusting the leveling screws until the glider will remain at rest.
2. Connect the photo gates to speed meter and switch it on.



3. Choose a spring with a constant k, attached freely to both mass gliders, one of which is unknown, and compress them between the stopper arm.
4. Remove the stopper arm to let masses to move freely in opposite sides.
5. Record the speeds of both masses.
6. Repeat steps 3-4 for 2 more times and tabulate the measured speeds.
7. Repeat steps 3-6 with another spring of different k.
8. Draw the relation between v_2 on x-axis and v_1 on y-axis and calculate the slope.
9. Calculate m_2 from the relation

Slope= m_2/m_1.

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Results

$m_1 =$ gm

Spring	1		2		3		4		5	
Trial	v_1	v_2	v_1	v_2	v_1	v_2	v_1	v_2	v_1	v_2
v_{t1}										
v_{t2}										
v_{t3}										
v_{tav}										

$m_2 =$ gm