611-0100 (40-160) Force Mechanism Trough

Safety:
Please have all students wear safety goggles.

Introduction:

This is a low-cost lab for studying acceleration and the effect of gravity of a moving body. Determine acceleration, speed and distances attained when applying a variable force.

Experiment 1

1. Place one or more steel balls toward the middle of the track.
2. Place one or more steel balls against spring-activated trigger mechanism. Pull back trigger, strike balls, hit balls placed further down track.
3. Observe how far and how many balls move.
4. Vary the force applied by using any of the 4 trigger positions.

Experiment 2

1. Prop the non-trigger end of the trough on a ring stand or block to create an incline, for example, 35°.
2. Shoot one ball up. Watch how long it takes for the ball to go up and then down.
3. Take the wood block and position it so pointed end fits in trough. Shoot the block up the track.

(**Note**: Only use the first three notches for this experiment. The fourth notch makes the spring too taut and will launch the wood part off off the track.)

How long does it take the block to go up and down?

In the case of the ball, up and down times are close. But with the block, the time up is much less than the time down. Why? Because the block has sliding friction which is much greater than the rolling friction of the ball. Frictional forces always oppose the force acting on the object. When an object goes up, frictional force opposes the gravitational force, thus speeding up the object. When the object falls frictional force retards the fall, thus slowing it down.

Experiment suggested by Dr. A.Z.M. Ismail, Professor of Physics at Daemen College, Amherst, N.Y.

Theory:

An elastic collision is involves the full conservation of both momentum and energy. Objects involved in elastic collisions behave in a restricted manner. For a given set of precollision conditions, there is one, and only one, set of results. This can be demonstrated by using balls of uniform mass. Balls are used because they have low friction in their movement. Hard materials despite appearance are usually more elastic than soft ones.

Momentum is always conserved. The product of mass times velocity after a collision is the same as before. If the colliding masses are equal in mass, the mathematical treatment is simpler.

Place several balls in the collision ball apparatus. For example, use **four balls** of equal mass placed **near the middle of the track** and in close contact.

If the group of balls is struck by a fifth one, also of equal mass, moving at a velocity **V**, the momentum of this ball (**mV**) would be imparted to the four it had struck.

You could expect any of the following conditions to satisfy conservation of momentum:

A **One ball departs at velocity V**

B **2 balls depart at velocity 1/2 V**

C **3 balls depart at velocity 1/3 V**

D **4 balls depart at velocity 1/4 V**

If you expect the conservation of energy to be 1/2 mV^2, the mV^2 of the departing balls must equal the mV^2 of the original moving ball.

For the four conditions above, the energies of the departing balls would be:

A = $\mathbf{1/2\ mV^2}$

B = $\mathbf{2 \times 1/2\ m \times (1/2V)^2}$

or

$\mathbf{1/4\ mV^2}$

C = $\mathbf{3 \times 1/2m \times (1/3V)^2}$

or

$\mathbf{1/6\ mV^2}$

D = $\mathbf{1/8\ mV^2}$

For the sake of simplicity the collision of balls of different masses has been omitted. If balls of different masses where included, you would have to consider the velocity of rebound of the striking mass.

You can see that only Condition **A** meets the requirement of conserving both momentum and energy. Therefore, when one moving ball strikes, only one ball departs and at the same velocity as the striking ball. (See if any other possible combinations would conserve both momentum and energy.)

Warranty:

We replace all defective parts free of charge. All products are warranted to be free from defect for **90 days.** This warranty does not apply to accident, misuse, or normal wear and tear.

P/N 24-4162