# 25 Go Cart

## Purpose

To investigate the momentum imparted during elastic and inelastic collisions

## Required Equipment/Supplies

"bouncing dart" from Arbor Scientific
ring stand with ring
dynamics cart (with a mass of 1 kg or more)
string
pendulum clamp
C-clamp
meterstick
brick or heavy weight

## Discussion

If you fell from a tree limb onto a trampoline, you'd bounce. If you fell into a large pile of leaves, you'd come to rest without bouncing. In which case, if either, is the change in your momentum greater? This activity will help you answer that question. You'll compare the changes in momentum in the collision of a "bouncing dart" when bouncing does take place and when it doesn't.

The dart consists of a thick wooden dowel with a rubber tip on *each* end. Although the tips look and feel the same, the tips are made of different kinds of rubber. One end acts somewhat like a very bouncy ball. The other end acts somewhat like a lump of clay. They have different *elasticities*. Bounce each end of the dart on the table and you'll easily see which end is more elastic. In the activity, you'll do the same against the dynamics cart using the dart as a pendulum.

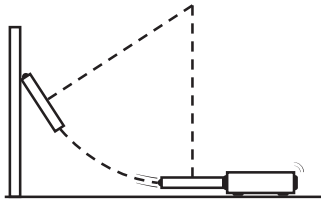
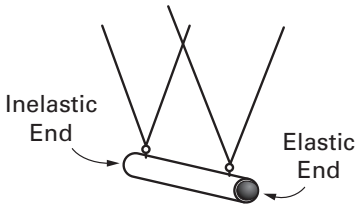


**Fig. A**




## Procedure

**Step 1:** Attach the dart to the ring stand as a pendulum, using a heavy weight to secure the base of the ring stand. To prevent the dart from swinging into the weight, position the ring on the stand so that it faces the opposite direction. Adjust the string so that the dart strikes the middle of one end of the cart when the dart is at the lowest point of its swing.

**Step 2:** Elevate the dart so that, when impact is made, the cart will roll forward a foot or so on a level table or floor when struck by the inelastic end of the dart. Use a meterstick to measure the vertical distance

*Observe collision without bouncing.*

Activity

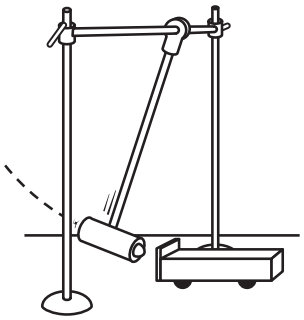
between the release point of the dart and the bottom of its swing. Repeat several times. Record the average stopping distance of the cart.

vertical distance = _____

stopping distance (no bouncing) = _____

*Observe collision with bouncing.*

**Step 3:** Repeat using the elastic end of the dart. Be sure to release the dart from the *same position* as in Step 2. Note what happens to the dart after it hits the cart. Make sure to release the dart from the same height each time. Repeat several more times to see whether your results are consistent. Record the average stopping distance of the cart.



**Alternate setup**

stopping distance (with bouncing) = _____

Write down your observations.

_____

_____

_____

_____

## Analysis

**1.** Define the momentum of the swinging dart before it hits the cart to be positive, so that momentum in the opposite direction is negative. After the dart bounces off the cart, is its momentum negative or positive?

_____

_____

_____

_____

_____

_____

**2.** When does the dart acquire the greater momentum—when it bounces off the cart or when it doesn't? Explain.

_____

_____

_____

_____

**3.** When does the *cart* undergo the greater change in momentum—when struck by the end of the dart that bounces or by the end of the dart that doesn't bounce? Explain.

**4.** How do the stopping distances of the cart compare?

**5.** How would you account for the difference in stopping distances?