# Coin and Feather Demo

P1-5200

## INSTRUCTIONAL GUIDE

## Contents

- Tube with coin and feather inside
- Pressure Tube
- Instructional Guide

**Required but not Included:**

- Vacuum pump that can reach 24-27 in Hg (P7-6502)

## Demonstration

Show students the coin and feather in the tube. Ask which will fall to the bottom of the tube first when you turn it on end. (Most will predict the coin.) Turn the tube quickly to vertical, and observe that the coin does indeed fall faster.

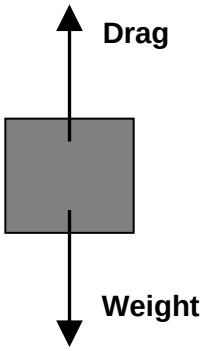
Any electric vacuum pump that reaches 24-27 in Hg can be used. We recommend our **Electric Vacuum Pump** to work with the Coin & Feather demo. Reduce the pressure to 1.25 in Hg (30 mm Hg) or less. If your pump gauge shows gauge pressure rather than absolute pressure, reduce it to -27 in Hg (-700mmHg) or further.

Repeat the demonstration, quickly turning the tube to vertical. Observe that now the coin and feather fall equally fast.

**TIP:**
If you notice that the feather is sticking to the inside of the tube, try rubbing the outside with a damp paper towel or cloth to discharge any static buildup.

## Explanation

A falling object experiences two important forces: weight (down) and drag (up). Drag is a force that opposes motion, and depends on complex factors including the object's velocity, the reference area, and the density of air (or whatever fluid through which the object moves). The net force causes the object to accelerate. When weight equals drag, the object stops accelerating and reaches its terminal velocity.




$$acceleration = F_{net} / mass$$

$$F_{net} = Weight - Drag$$

When Weight = Drag, $F_{net}$ is zero, and the object stops accelerating. For a light object with a large surface area, such as a feather, the two forces become equal very quickly, and the object has a slow terminal velocity. When you remove the air, the drag on both objects essentially becomes zero.

Then, **for both objects:**

$$F_{net} = Weight = mass \bullet g$$

$$Acceleration = F_{net} / mass = mass \bullet g / mass$$

$$Acceleration = g = \mathbf{9.8\ m/s^2}$$

## More Information

This idea was first proposed by Galileo. His theory was finally tested in 1971. Watch Apollo 15 astronaut David Scott drop a hammer and a feather on the moon: http://youtu.be/5C5_dOEyAfk

More on drag and falling objects: https://www1.grc.nasa.gov/beginners-guide-to-aeronautics/falling-object-with-air-resistance/