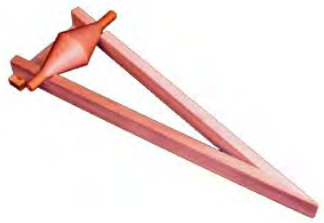
24-40515 (40-515) Double Cone and Plane



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How to Teach with the Double Cone and Plane:

Concepts Taught: Force and Motion

Curriculum Fit: Mechanics; Center of Gravity

Additional Materials Needed:
- Protractor

Theory: Defy gravity as our cone appears to roll upward. This visual demonstrator of the center of gravity consists of a wooden frame with diverging rails and a double-ended cone. The cone appears to roll upward; in actuality, it is the center of mass that is moving downward.

Demonstration: Ascending Cone
1. Place the double cone at the bottom of the inclined plane (where it forms the small "V") and watch as it ascends along the inclined plane.
2. The physical explanation of this demonstration is as follows:
   a. The center of mass of the cone is descending.
   b. The motion may be described by the energy conservation law for the cone-Earth as follows:

$$\left(\frac{1}{2}\right)mv^2 + \left(\frac{1}{2}\right)J\omega^2 + mg\,\mathrm{w} = \text{const}$$

$$\mathrm{J} = \left(\frac{3}{5}\right)mR^2 = \text{rotational inertia of double cone with respect to symmetry axis}$$

Where,

m = mass (g)
R = radius (cm)

w = instantaneous height of center of mass of double cone over zero level of potential energy

v = velocity (m/s^2)

ω = angular velocity (rad/s)

c. We can form some qualitative observations about the double cone and plane. Where both apexes of the double cone lie on the tracks, they are zero distance from the rotational axes. We are able to predict that at the end of the ideal experiment, the cone rotates on apexes around its symmetry axis which is at rest. However, in the real experiment, the rotational motion is stopped by frictional forces.

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611-0070 Duff's Inclined Plane - This unusual apparatus, named after Wilmer Duff of Worchester Polytechnic, is a simple method of studying uniformly accelerated motion. It uses the iso- chronous oscillation of a ball rolling back and forth in a cylindrical trough as a time marker. It consists of a stiff plastic trough, bright red in color, 1 m long, elevated at one end to form a very slight incline. The fact that a ball is rolling down the incline, instead of a sliding block, changes the mathematical workup performed in most physics lab today. The path of the ball crosses the midline of the trough at equal times, yielding information about the position of the ball as a function of equal time intervals.