ARBOR SCIENTIFIC 96-1010 Visible Variable Inertia Set Installation Guide

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Installation Guide

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Visible Variable Inertia Set

- 2 clear variable inertia disks
- 8 steel spheres, 19 mm (3/4”) diameter

Recommended for Activity:

- Inclined Plane (P3-3541)

Background

This is a unique activity that is simple to set up and qualitatively illustrates an abstract concept in an easy-to-understand manner. It consists of two plastic discs in two halves (4 halves total) with the same mass and diameter. The discs are hollow inside with compartments allowing arrangement of the ball bearings into a variety of configurations. You can place the steel balls (19mm ball size) along the rim of the discs, in the center, or in a straight line across, as illustrated. This effectively varies the distribution of mass around the center, around the edge, or a variety of combinations.

Introduction

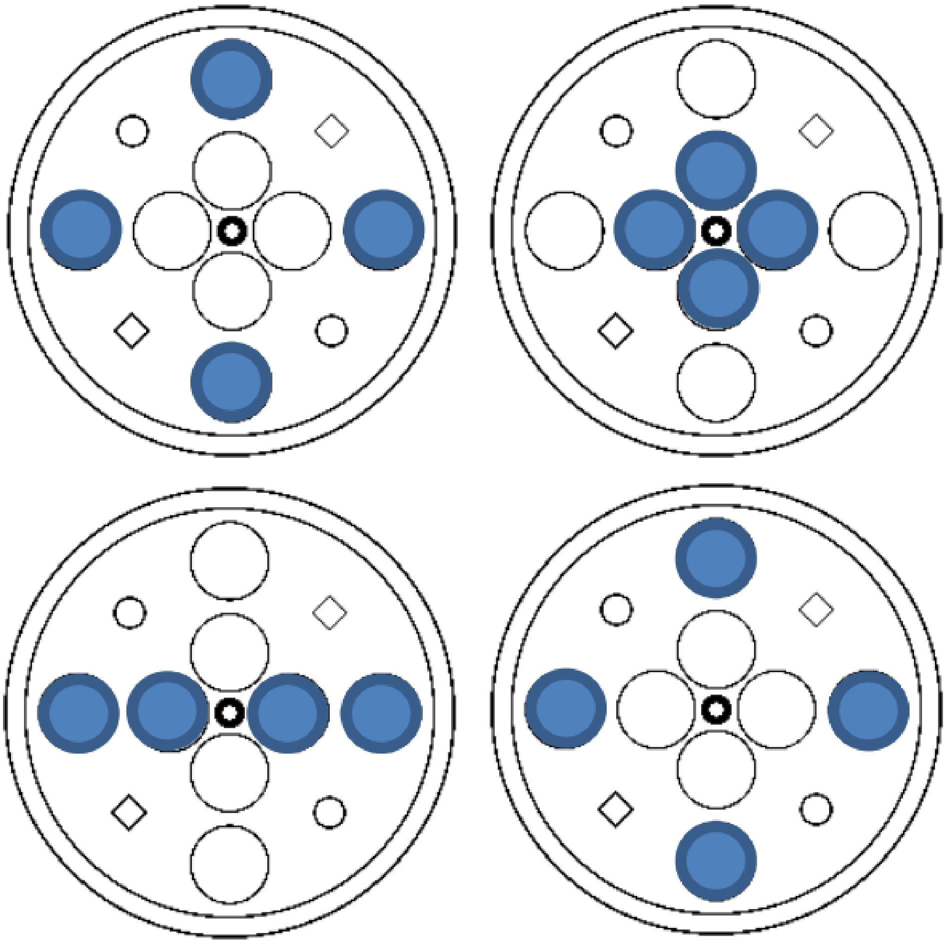
In rotating systems, the rotational inertia is analogous to the mass in linear systems. Rotational inertia depends on the mass and how the mass is distributed around the point of rotation: the farther away, the higher the rotational inertia. Rotational inertia, like mass, resists acceleration. The higher the rotational inertia, the more torque it takes to cause rotational acceleration.
When a body rotates or spins about an axis, the angle made by its rotating mass, with the axis, in the plane of rotation is changing with time; that is, there is an angular velocity. This is zero when the body is not spinning. On the other hand, if angular velocity increases (or decreases), there is angular acceleration. When you change the rotational motion of a body, you change its angular velocity or give it an angular acceleration/deceleration.
Just as a linear force causes the change in linear motion, Torque (τ), causes the change in rotational motion. This relationship is expressed with the equation:
$= \alpha$
where I is the moment of inertia of the body and α is its angular acceleration. The greater the moment of inertia of a body, the greater the torque that would be needed to give it an angular acceleration. But what makes the moment of inertia of a body greater (or smaller)? One factor is its mass. Heavier objects have greater inertia. However, objects with the same mass react differently to rotating forces depending on where their masses are concentrated about the axis of rotation.

Set-Up

Set up an inclined plane about one meter long for the best results. A backstop or catcher also helps to keep the disks from running away. The inclined plane should be raised to a fairly shallow angle. This prevents the disks from slipping down the plane and slows the acceleration of the disks so the results can be easily observed.

Activities

1. First, remove the ball bearings from each disk. Place and hold the two discs (on their edges) side by side at the top of the incline and let them go simultaneously. Note their relative speeds by watching them from the side. This should result in the disks reaching the bottom at the same time since their inertia is identical.
2. Use the ball bearings to change where the mass is distributed in the two shells. Load one of the discs with 4 ball bearings in the outer rim, and load ball bearings into the inner circle compartments of the other. Roll them down the incline as before.



3. Try the experiment with one disk loaded with four ball bearings in a line and the other with 4 ball bearings loaded in the outside compartments. Roll them down your incline. Compare their speeds.
4. So far you have kept the mass of the two discs equal, loaded or unloaded. Now experiment with the two discs loaded so their weights become different. For example, use four bearings on one disk in the center and only two on the outer rim of the other. Compare their rolling speeds again.

Recommended

Gyroscope Wheel (93-3501) Adjustable masses and large-scale demonstrations make it easy for students to experience complex concepts of procession and inertia.
Rotational Inertia Demonstrator (P3-3545) Observe the angular acceleration of the apparatus and investigate the effects of changes in torque and inertia.
Exploring Newton's First Law (P6-7900) Students investigate inertia by observing a marble's motion around a specially designed circular track.

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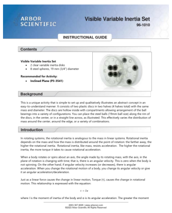
Documents / Resources

	ARBOR SCIENTIFIC 96-1010 Visible Variable Inertia Set [pdf] Installation Guide 96-1010 Visible Variable Inertia Set, 96-1010, Visible Variable Inertia Set, Variable Inertia Set, Inertia Set, Set

References

- Physics and Chemistry Science Lab Equipment – Arbor Scientific
- Physics and Chemistry Science Lab Equipment – Arbor Scientific
- Exploring Newton's First Law: Inertia Kit - Arbor Scientific
- Gyroscope Wheel – Arbor Scientific
- Inclined Plane - Arbor Scientific
- Rotational Inertia Demonstrator - Moment of Inertia - Arbor Scientific