CENTRAL SCIENTIFIC COMPANY

OPERATING INSTRUCTIONS

Center of Mass Demonstrator
No. 74836

1. Introduction

The Center of Mass Demonstrator is designed to illustrate the position of the centers of mass of differently shaped objects.

2. Description

The Center of Mass Demonstrator consists of four black geometric shapes: an equilateral triangle, a sector of a circle, a half-circle, and an irregular shape. Also included are an adapter from which the shapes are suspended, a plumb line and plumb, and several pieces of chalk.

3. Experiment

Determine the center of gravity or mass of each geometric shape by suspending the shapes from a ringstand. For example, the equilateral triangle is hung successively from the predrilled holes in each apex. Each time, the chalk line is attached at the point of suspension and snapped against the figure, leaving a vertical line of chalk. The center of mass is where the lines intersect. This can then be checked by punching a hole where the lines intersect, suspending the shape from the hole, and noticing that it remains in equilibrium independent of orientation about the point of suspension. In the case of the irregular shape, it is found that the center of mass lies outside the body since the chalk lines do not intersect on the shape.

4. Discussion

The above experiment proves that the center of gravity of an equilateral triangle lies at the intersection of the medians. The center of gravity of a sector of a circle is at $\overline{x} = (2R \sin \theta) / 3\theta$ where θ is the semivertex angle, in this case 30°. Accordingly, for this sample $\overline{x} = 2R / \pi$ (see Figure 1).

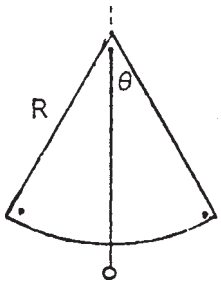

Figure 1

The semicircle is a sector of total angle π. Accordingly, $\overline{\mathbf{x}}$ becomes $4R / 3\pi$. The irregular sample yields this interesting observation: *The center of gravity of a body does not have to lie where there is matter*. So, the plumb lines intersect where there is nothing — the center of gravity of a doughnut, for example is in the middle of the hole.

5. Additional Projects

1. Take two corks and fit them with pins or needles as shown in Figure 2.

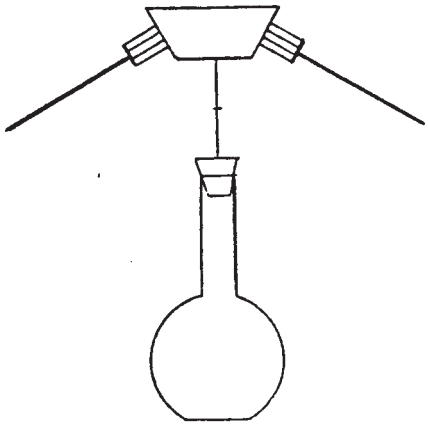

Figure 2

Suspend two forks from the upper cork. You will have to grind or file flat the tip of the lower pin or needle to provide a surface for the upper needle to stand on. If the largest corks available are too small to raise the ends of the forks above the surface of the table, the lower cork can be fitted into the mouth of a flat-bottomed flask. In this way, the entire assembly can be raised. The system can be put in the most unusual configurations, retaining its stability all the while. This may appear mystifying at first, but this is only because of the peculiar mass distribution that gives rise to a center of gravity that does not lie on the body. For the system to remain in equilibrium, the center of gravity must lie below the point of support. Therefore, any small displacement will give rise to a restoring torque that tends to rotate the system back to its equilibrium position.

2. Out of wood or plastic cut a shape like in Figure 3.

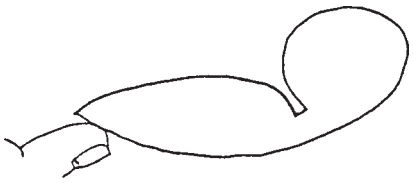

Figure 3

The notch must be at least 2 inches deep and 1/4 inch wide. The shape must also be at least 1 inch thick. Now ask students to figure out a way in which this shape can be suspended from a fingertip as shown in Figure 4. Tell the students they may have some object on them that will make it possible to do this. The answer is a belt. Let one of the students remove his or her belt and place it in the slot. This will result in the center of gravity of the whole system being under the fingertip. The shape made with the belt will then rest in equilibrium.

6. Maintenance

The Center of Gravity Demonstrator needs no special maintenance. Should any difficulty develop with this apparatus, please contact Central Scientific Company giving details of the problem. To ensure better service, please do not return any item to Central Scientific until we have sent written authorization.

7. Copyright Notice

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