

## 37.5: Routh's Rule

Routh's rule is a mnemonic formula for finding the moment of inertia of a symmetrical solid. The rule works for a circular or elliptical cylinder rotated about the cylinder axis, or for a circular or elliptical disk about any of the axes of symmetry.

Routh's rule states that the moment of inertia  $I$  of a body of mass  $M$  about an axis is given by

$$I = M \left( \frac{\text{sum of squares of the perpendicular semi-axes}}{3, 4, \text{ or } 5} \right) \quad (37.5.1)$$

where the denominator is 3 for a rectangular body, 4 for an elliptical body, or 5 for an ellipsoidal body.

### ✓ Example 37.5.1

What is the moment of inertia of a circular disk of radius  $R$  rotated about an axis perpendicular to the plane of the disk and passing through its center.

#### **Solution**

The numerator in Eq. 37.5.1 is  $R^2 + R^2 = 2R^2$ , while the denominator is 4 (a circle is a special case of ellipse), so  $I = M(2R^2/4) = (1/2)MR^2$ .

### ✓ Example 37.5.2

As a second example, we find the moment of inertia of a solid sphere rotated about an axis passing through its center.

#### **Solution**

The numerator of Eq. 37.5.1 is  $R^2 + R^2$ , while the denominator is 5 (a sphere is a special case of ellipsoid); hence  $I = (2/5)MR^2$ .

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