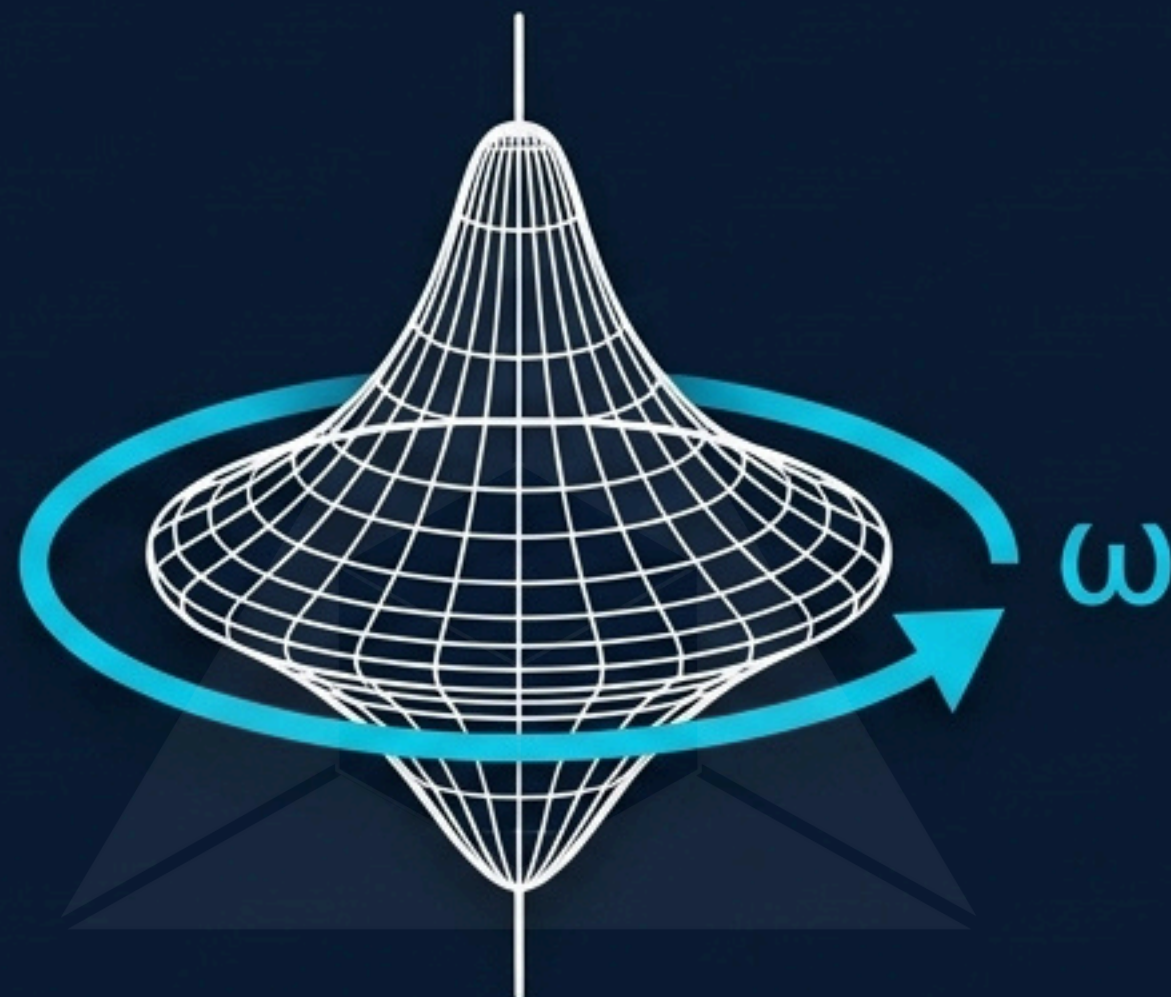




Conservation of Angular Momentum

NEET Physics | Systems of Particles & Rotational Motion (6.12.1)

The Spin Paradox

Why does an ice skater spin instantly faster just by pulling their arms to their chest?

No extra force is applied.

No one pushes them.

So where does the sudden speed come from?

Angular Velocity

Moment of Inertia



Key Formula

The Law of Conservation

If the total external torque on a system is zero, its total angular momentum is conserved.

$$\tau_{\text{ext}} = 0 \Rightarrow \frac{d\mathbf{L}}{dt} = 0$$

$$\mathbf{L} = \text{constant}$$

For a fixed axis: $I\omega = \text{constant}$

The Kinematic Balance

Because total angular momentum (L) is locked, I and ω must compensate for each other.



$$I \propto \frac{1}{\omega}$$

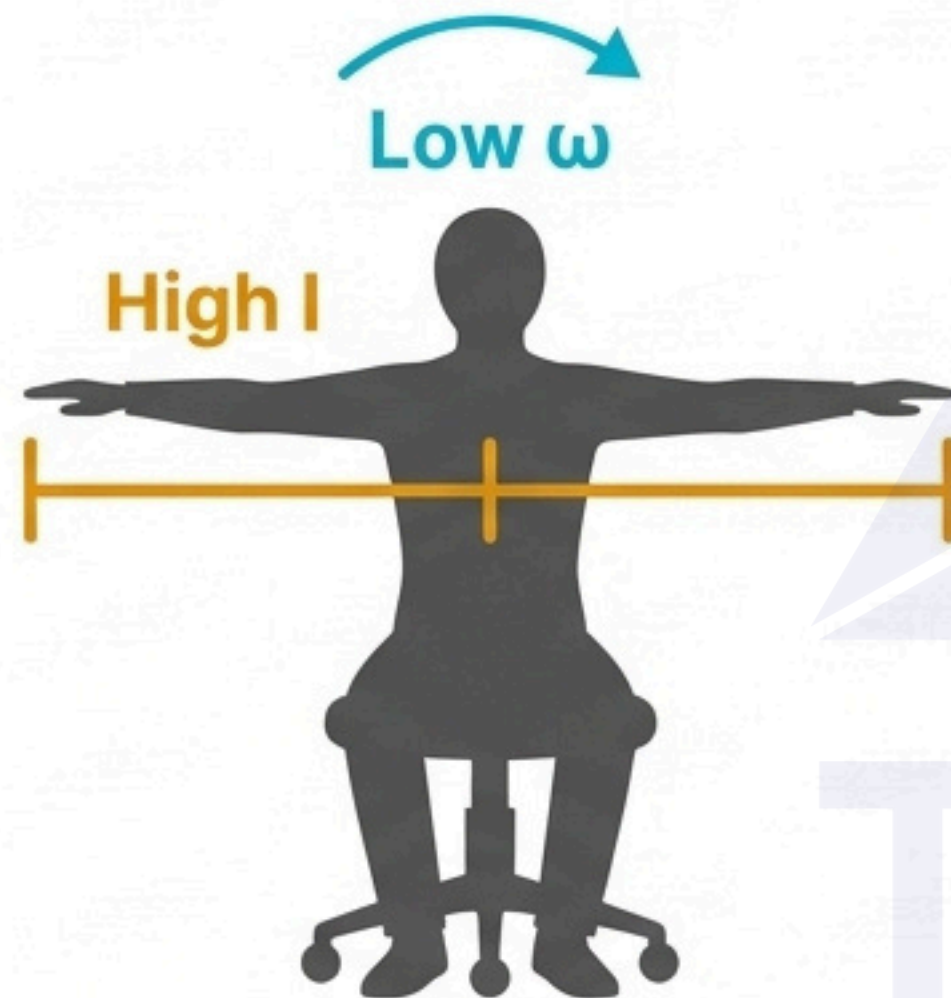
To change your speed,
simply change your shape.

The Swivel Chair Experiment

Friction is neglected ($\tau_{\text{ext}} = 0$)



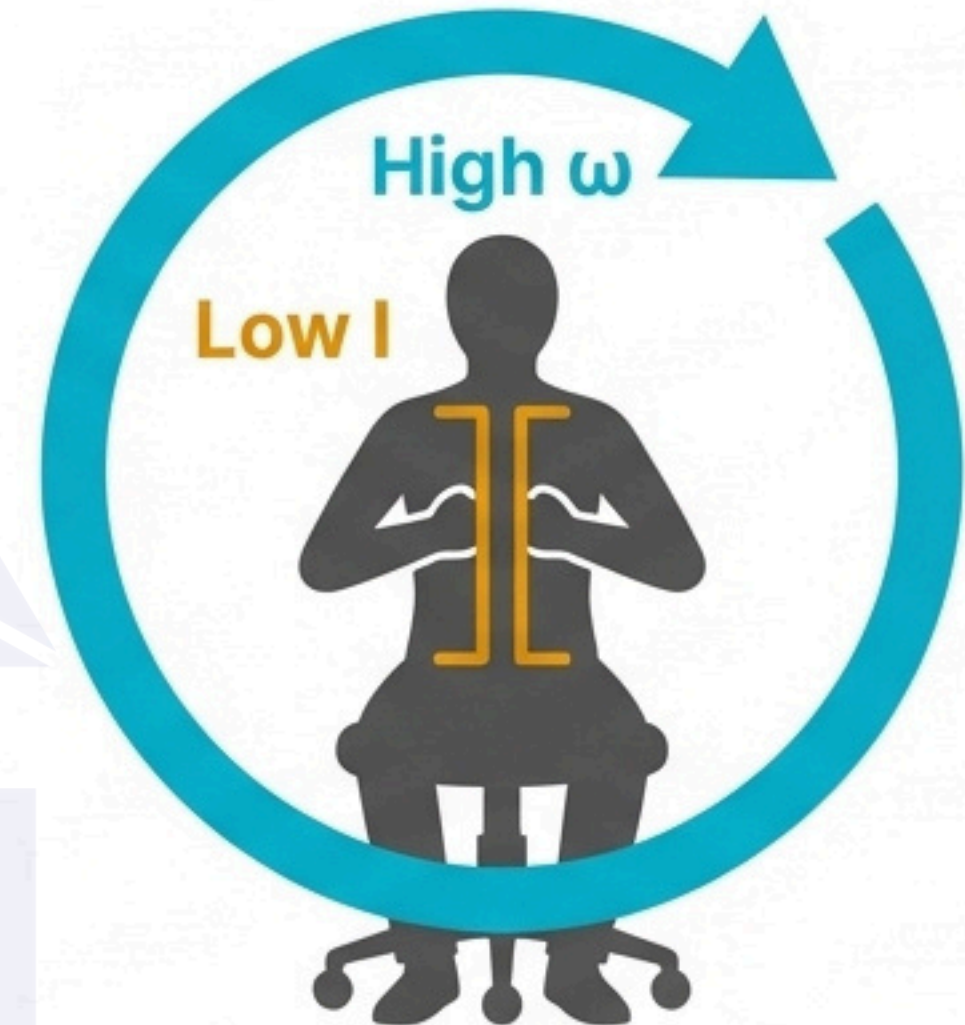
State 1: Expanded



Arms Out $\rightarrow$ Mass far from axis



State 2: Contracted

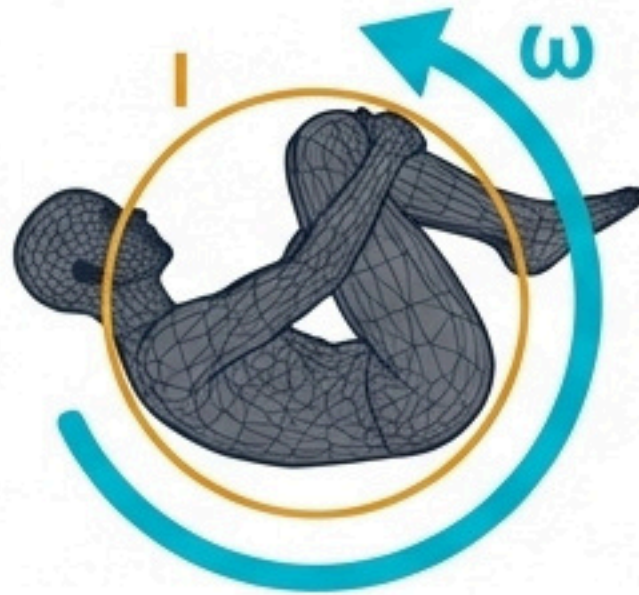


Arms In $\rightarrow$ Mass close to axis

The Universal Principle in Action

Exam Application

The Acrobat



The Acrobat

Tucking the body lowers I to complete multiple somersaults before hitting the water.

Exam Application

The Dancer

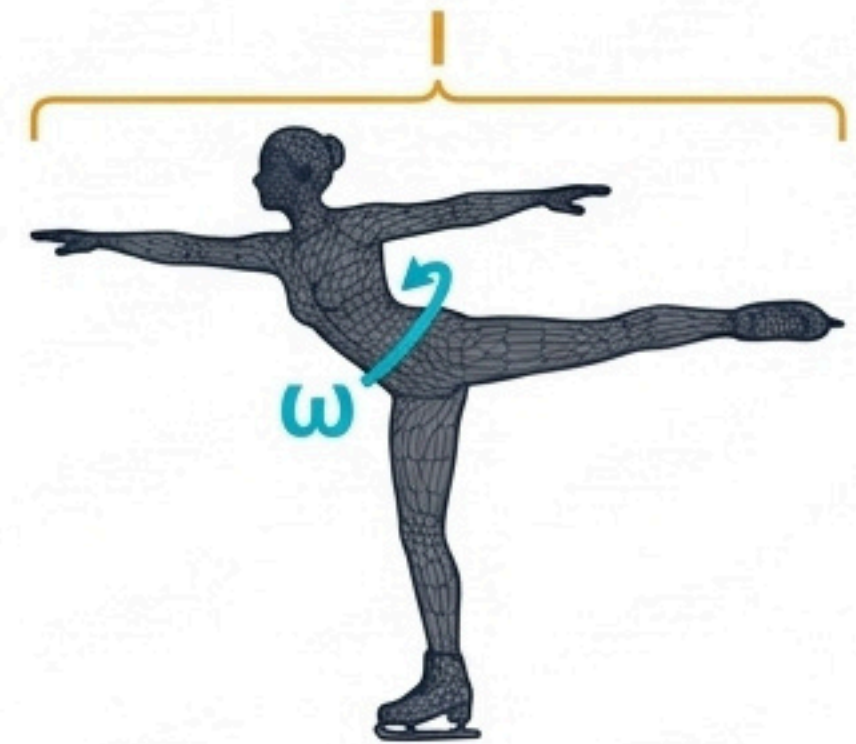


The Dancer

Pulling limbs tight to the vertical axis of rotation minimizes I to maximize spin speed (ω).

Exam Application

The Skater



The Skater

Extending arms and a leg instantly stops a rapid spin by massively increasing I .

Remember This

Exam-Ready Summary

- **The Golden Rule:** τ_{ext} must be strictly zero for $\mathbf{L}$ to be conserved.
- **Internal Independence:** Internal forces (like moving your arms) do not change total $\mathbf{L}$.
- **The Kinetic Energy Trap:** Rotational Kinetic Energy ($K = \frac{1}{2}I\omega^2$) actually increases when arms are pulled in. (Internal work is done by the person's muscles against outward centrifugal forces!).