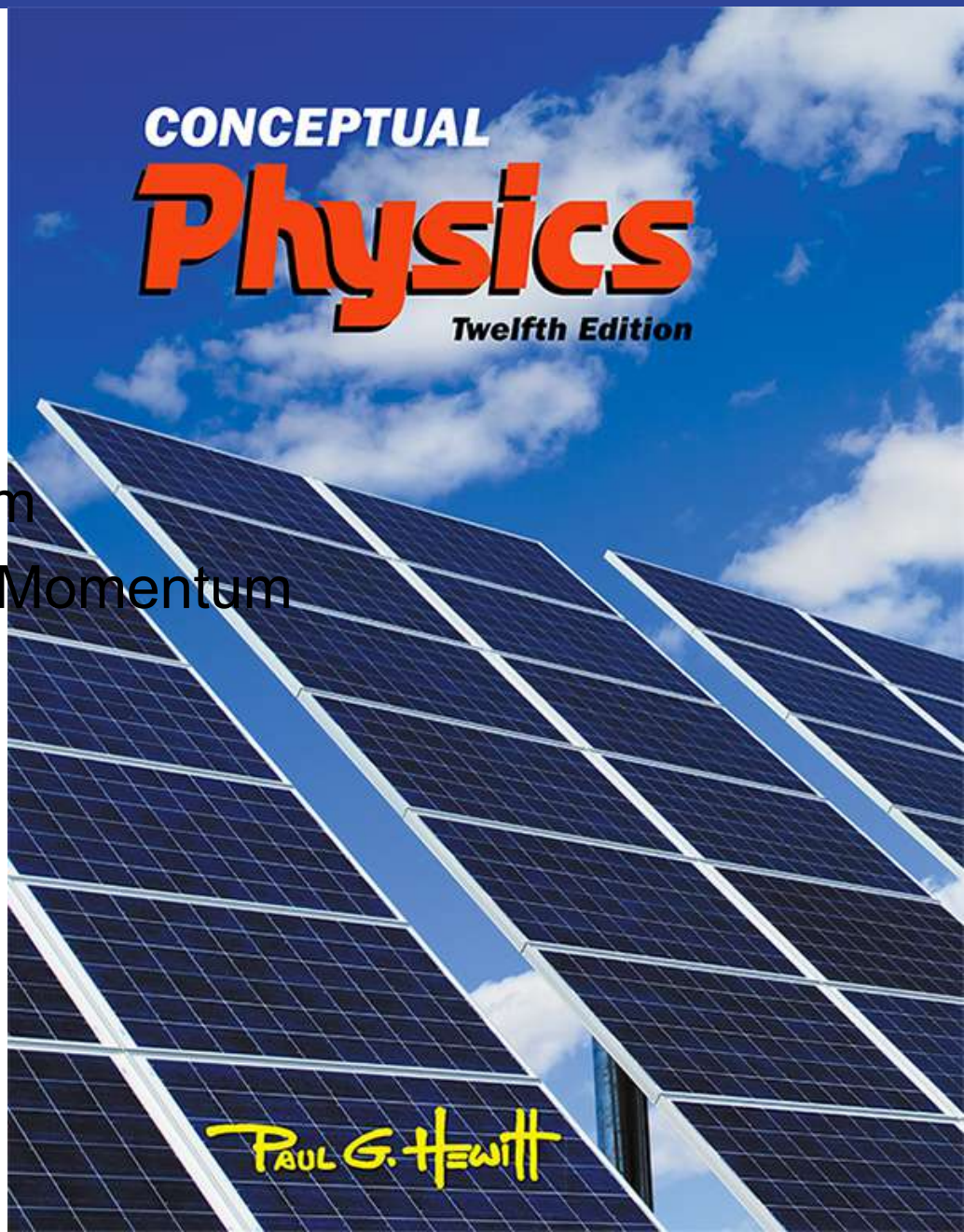
Lecture Outline

Chapter 8: Rotational Motion

Sections Angular Momentum

- Conservation of Angular Momentum



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This lecture will help you understand:

- Conservation of Angular Momentum

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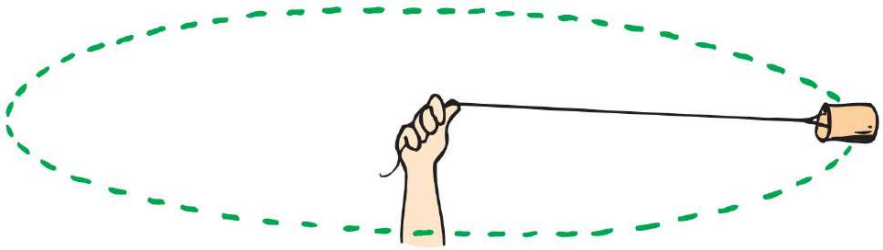
Ex. Using L = mvr

A can with a mass of 0.5 kg is swung around at a radius of 1 m at a speed of 4 m/s. Calculate the angular momentum of the can.



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Angular Momentum
CHECK YOUR ANSWER

Suppose you are swirling a can around and suddenly decide to pull the rope in *half*way; by what factor would the speed of the can change?

A. Double

Explanation:
Angular momentum =
mass tangential speed x radius

Angular Momentum is proportional to radius of the turn.

No external torque acts with inward pull, so angular momentum is conserved. Half radius means speed **doubles.**

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Conservation of Angular Momentum

- The **law of conservation of angular momentum** states:
  - If **no external net torque** acts on a rotating system, the **angular momentum of that system remains constant.**
- Analogous to the law of conservation of linear momentum:
  - If **no external force** acts on a system, the total **linear momentum** of that system remains constant.

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BEFORE:

$I = 20\ kgm^2$

$\omega = 30\ RPM$

AFTER:

$I = 10\ kgm^2$

$\omega = ?$

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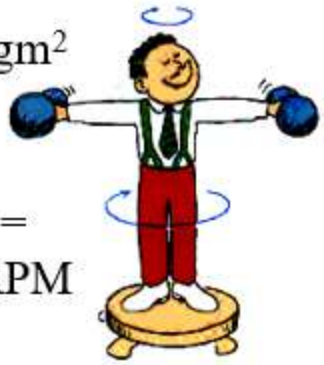
BEFORE

$I = 30\ kgm^2$

$\omega =$ 15 RPM



AFTER:

$I = ?$

$\omega =$ 45 RPM

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BEFORE:

$I = 28\ kgm^2$

$\omega =$ 20 RPM

AFTER:

$I = 7.0\ kgm^2$

$\omega = ?$

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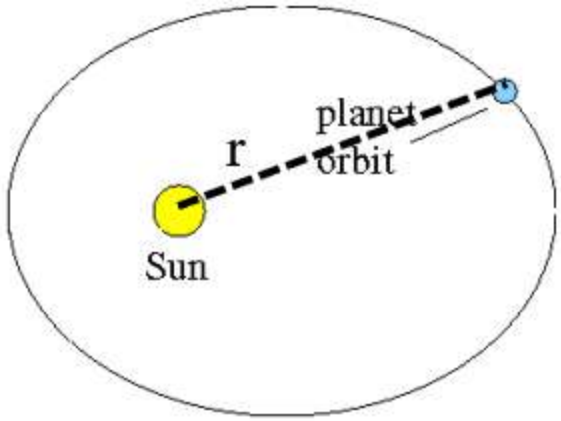

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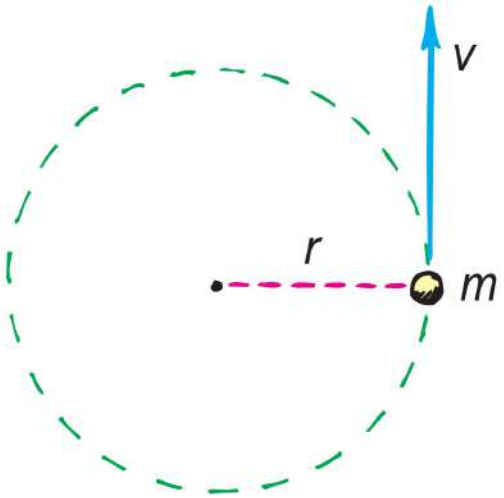
Angular Momentum: Simple objects

- Examples:
  - Whirling ball at the end of a long string
  - Planet going around the Sun



- For an object that is small compared with the radial distance to its axis, magnitude of

Angular momentum = mass x tangential speed x radius

$$L = mvr$$

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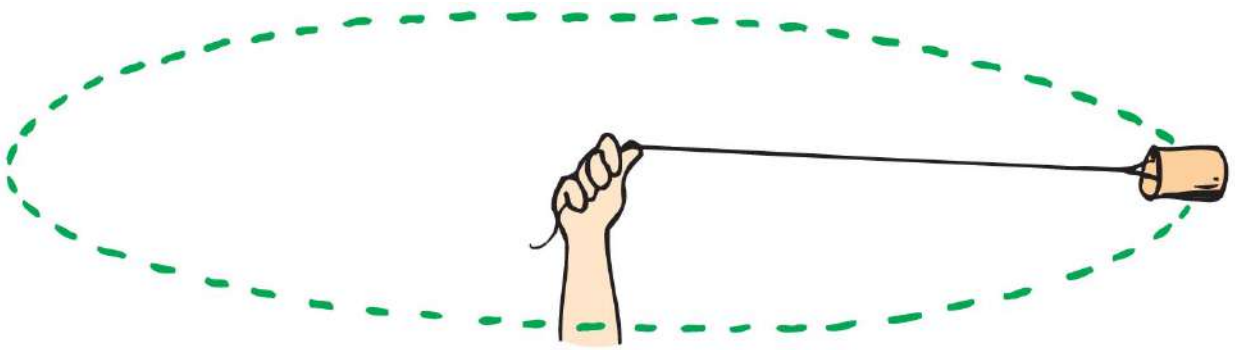
Angular Momentum
CHECK YOUR NEIGHBOR

Suppose you are swirling a can around and suddenly decide to pull the rope in *half*way; by what factor would the speed of the can change?

A. Double
B. Four times
C. Half
D. One-quarter



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Angular Momentum
CHECK YOUR ANSWER

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Explanation:
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Angular Momentum is proportional to radius of the turn.

No external torque acts with inward pull, so angular momentum is conserved. Half radius means speed **doubles.**

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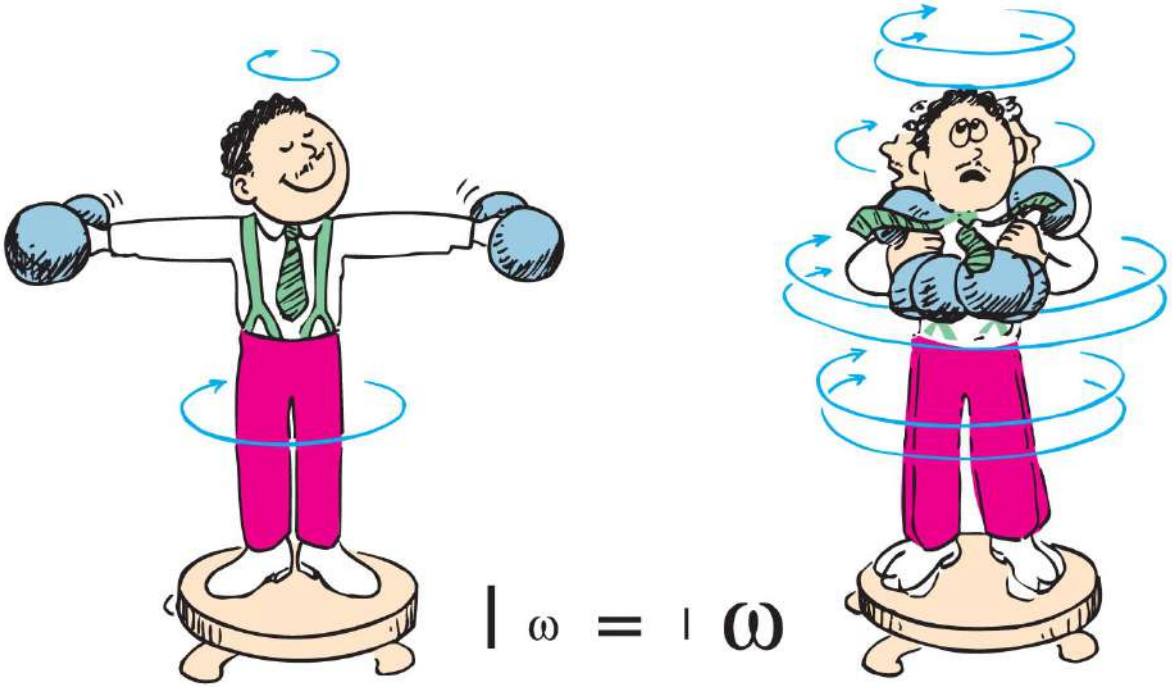
Conservation of Angular Momentum, Continued

- Example:
  - When the man pulls the weights inward, his rotational speed increases!



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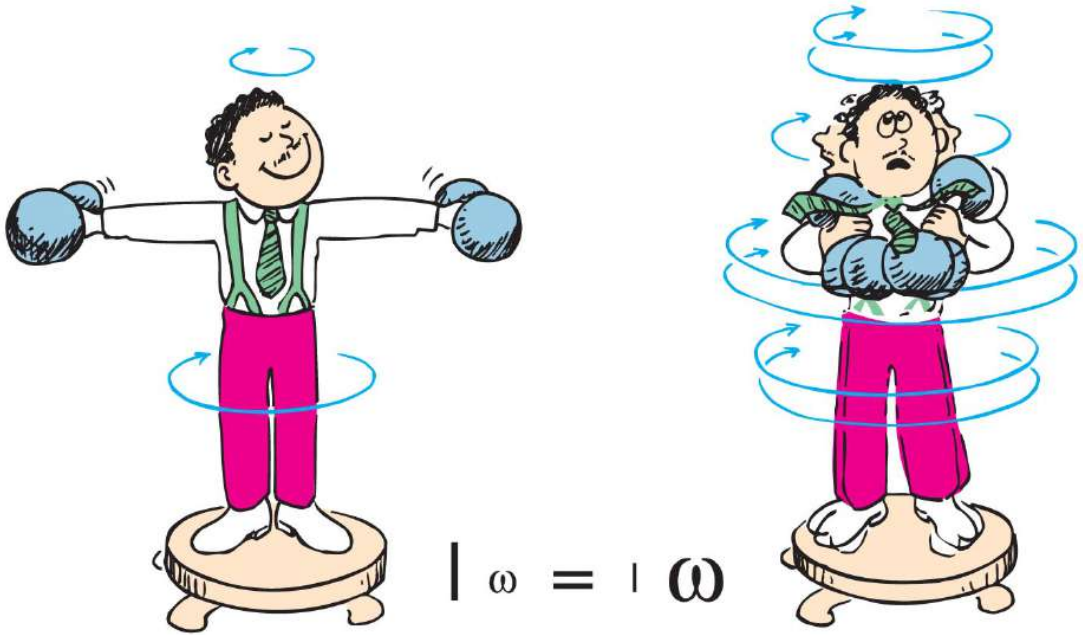
Angular Momentum
CHECK YOUR NEIGHBOR, Continued

Suppose by pulling the weights inward, the rotational inertia of the man reduces to half its value. By what factor would his angular velocity change?

A. Double
B. Three times
C. Half
D. One-quarter



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Angular Momentum
CHECK YOUR ANSWER, Continued

Suppose by pulling the weights inward, the rotational inertia of the man reduces to half its value. By what factor would his angular velocity change?

A. Double

Explanation:

Angular momentum = rotational inertia x angular velocity

Angular momentum is proportional to "rotational inertia."

If you *halve* the rotational inertia, to keep the angular momentum constant, the angular velocity would **double.**

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Homework

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