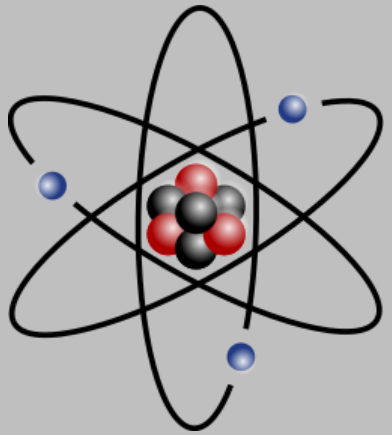
International House Tashkent
Subject: Physics
Department: ES, Course 1
Lesson 2. Rotary motion



Why rotational?

- We've focused on *translational* motion up to this point
- Rotational motion has things in common with translational motion
- Examples: spinning wheels,

  washing machine drum,

  merry-go-round, etc.

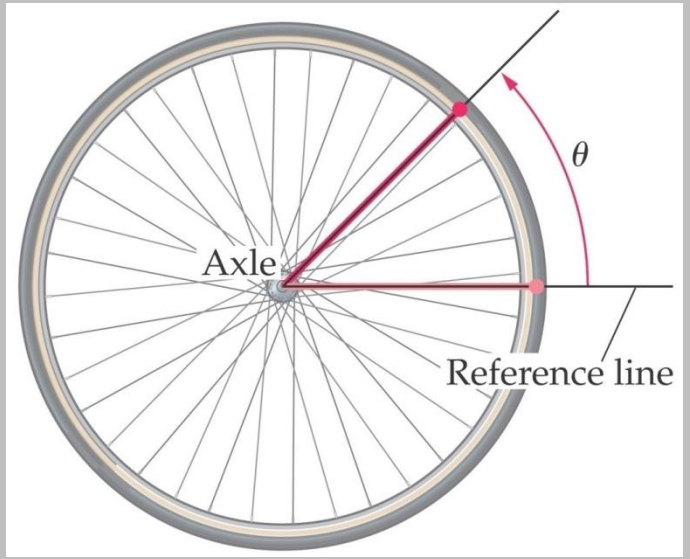
Angular Position

Definition of Angular Position, θ

θ = angle measured from reference line

SI unit: radian (rad), which is dimensionless

Angular displacement is the angle (in rads) through which a point or line has been rotated about an axis



Angular Velocity

The rate of change of angular displacement $\Delta\Theta$ with time Δt

Definition of Average Angular Velocity, ω_{av}

$$\omega_{av} = \frac{\Delta\theta}{\Delta t}$$

SI unit: radian per second (rad/s) $= s^{-1}$

Angular Acceleration

The rate of change of angular velocity

Definition of Average Angular Acceleration, α_{av}

$$\alpha_{av} = \frac{\Delta\omega}{\Delta t} \qquad \bar{\alpha} = \frac{\omega_2 - \omega_1}{\Delta t} = \frac{\Delta\omega}{\Delta t}$$

SI unit: radian per second per second $(\text{rad/s}^2) = \text{s}^{-2}$

Instantaneous Acceleration

$$\alpha = \lim_{\Delta t \to 0} \frac{\Delta\omega}{\Delta t}$$

Period

- The time it takes to complete one cycle or revolution. Also the reciprocal of the frequency.

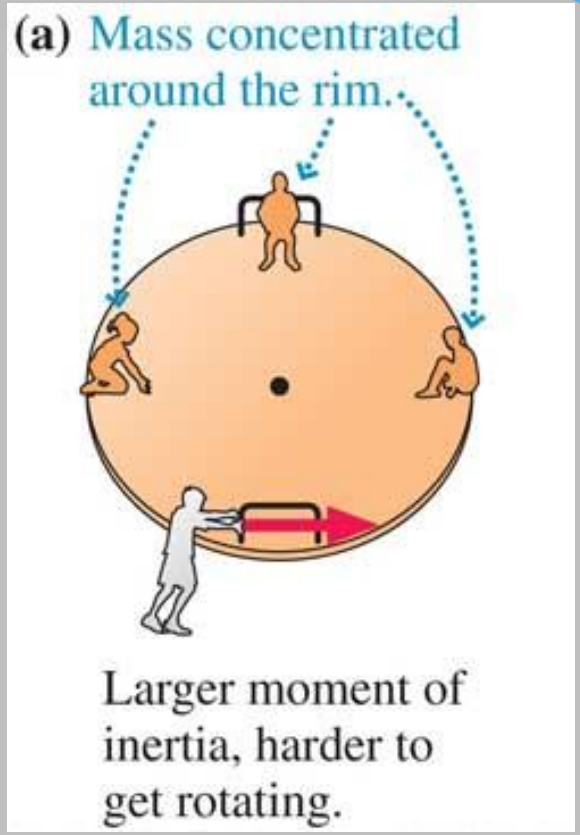
Definition of Period, *T*

$$T = \frac{2\pi}{\omega} \qquad T = \frac{1}{f}$$

SI unit: second, s

Moment of Inertia

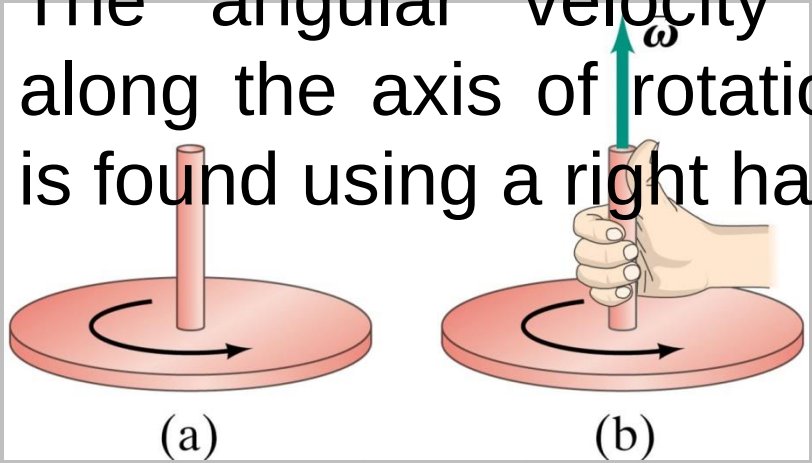
- The rotational equivalent of mass
- Symbolized with letter *I*



Vector Nature of Angular Quantities

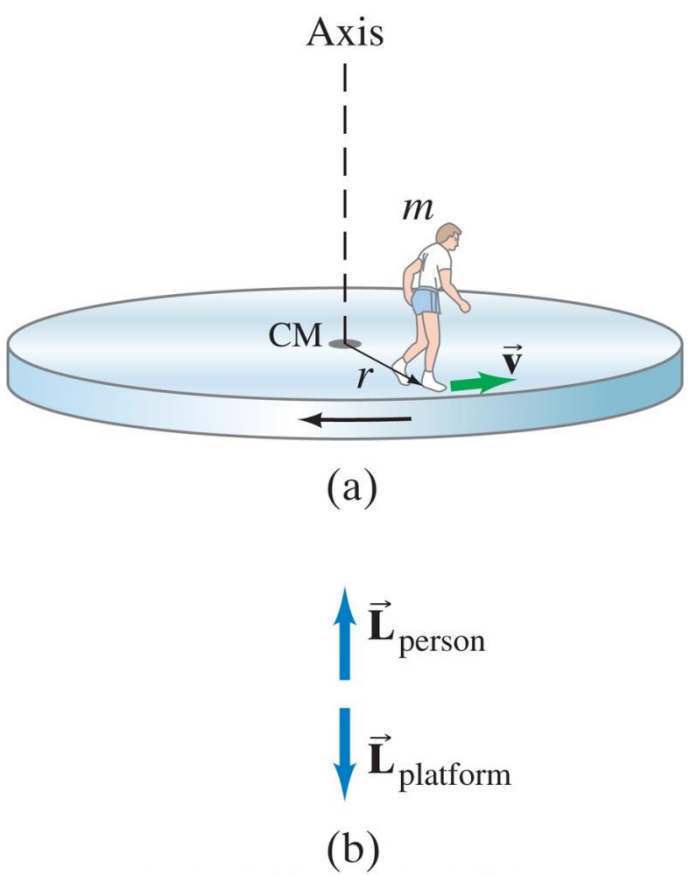
We have considered the magnitude of the angular quantities but must also define the direction!

The angular velocity **vector** points along the axis of rotation; its direction is found using a right hand rule:



1. Curl fingers around the axis in the direction of rotation
2. Thumb is pointing in direction of ω

Vector Nature of Angular Quantities



Angular acceleration and angular momentum vectors also point along the axis of rotation.