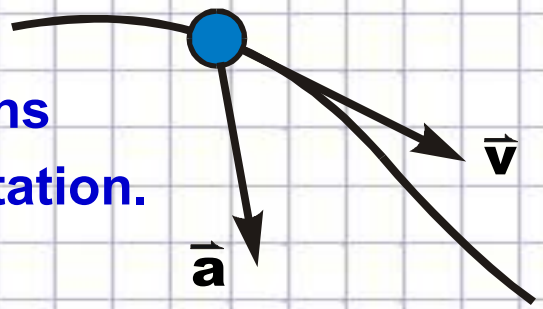
Ch. 16: Rigid Body Kinematics

(Exam 1: Particle Kinematics)

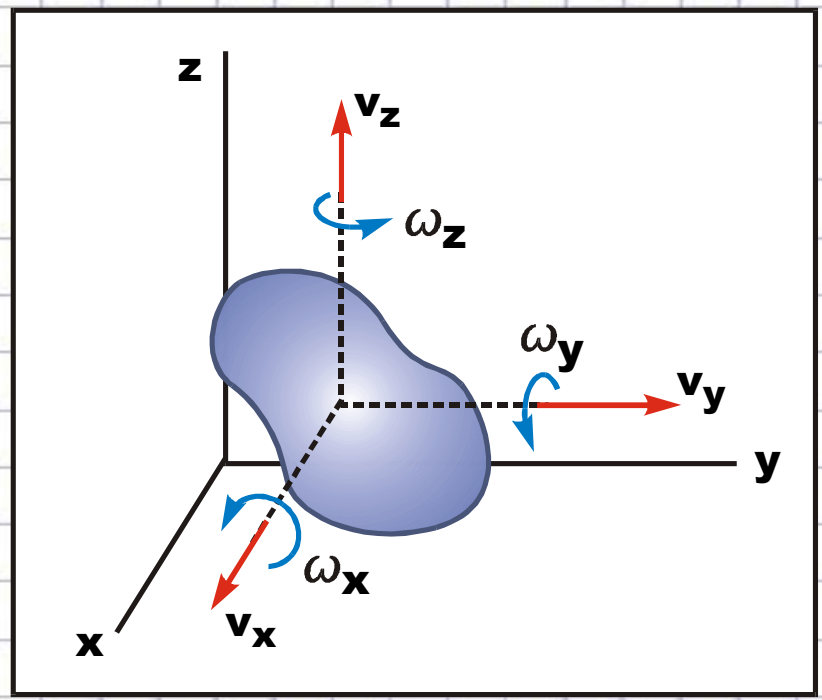


Particles:
- Insignificant Dimensions
- Only translation, no rotation.

Now: Rigid body motion, kinematics….

Rigid Bodies:
- Significant Dimensions
- Translation + Rotation

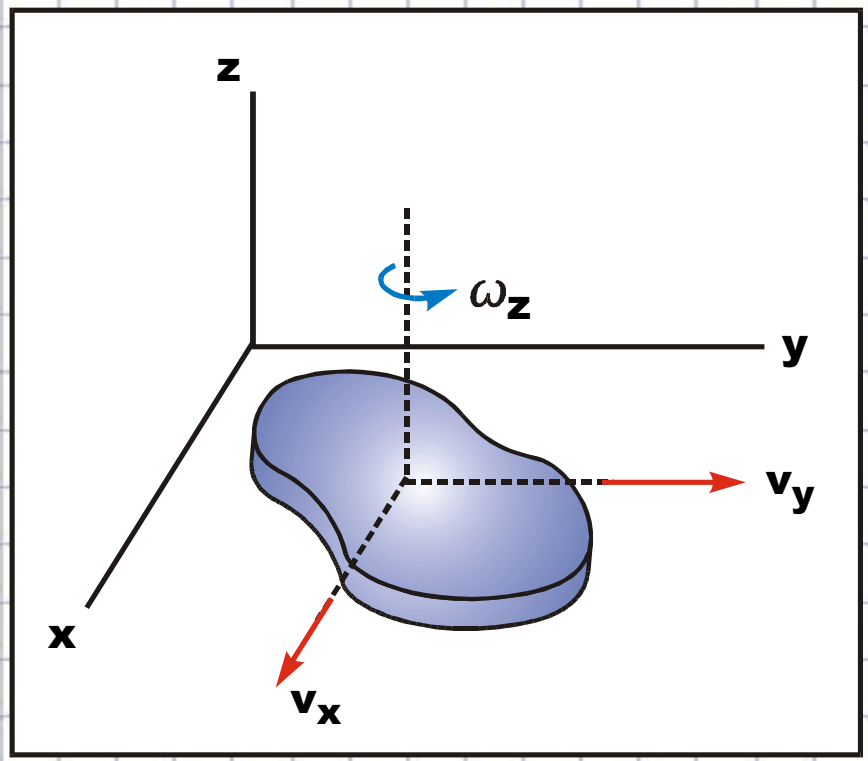
Rigid Body 3-D Motion:
- v_x, v_y, v_z translational components
- Rotations (ω_x, ω_y, ω_z) about three axes
- We will not cover general 3D motion in this class
  Just 2D (planar) motion



Rigid Body Planar Motion

Rigid Body 2-D Planar Motion:

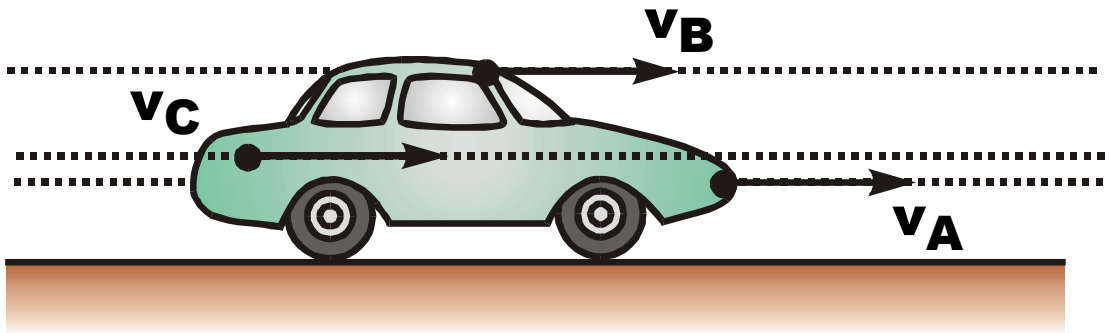
- v_x, v_y translational components (also accels a_x, a_y)
- Rotation (ω_z) about z axis only ($\perp$ to page)



Types of Rigid Body Planar Motion

- Translation (today's class)
- Fixed Axis Rotation (today's class)
- General Plane Motion (next 4 or 5 classes…)

Translation: All points have same velocity, same path.



Translation: $v_C = v_B = v_A$

$\omega = 0$

All points have exact same velocities and move along identical, parallel paths.

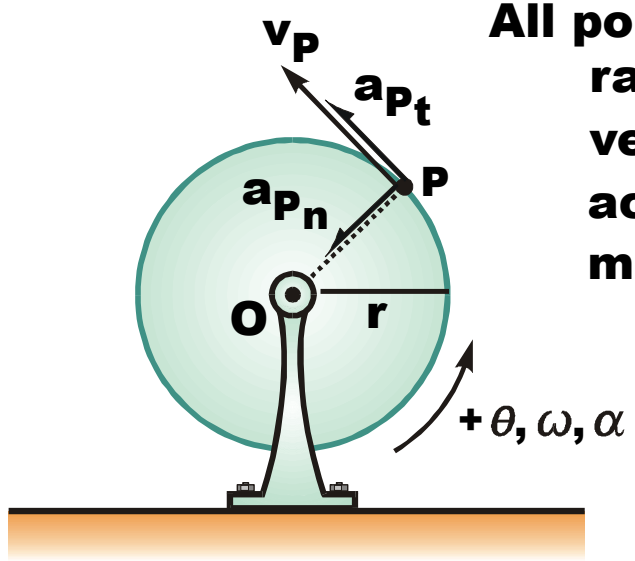
Types of Rigid Body Planar Motion (cont'd)

Fixed Axis Rotation: The body rotates around a pin which has a zero velocity. All points move in circles.

All points at the same radius have the same velocity and acceleration magnitudes. There are an infinite number of possible radii, from zero to r.

Fixed Axis Rotation

All points move in circles around the pin.

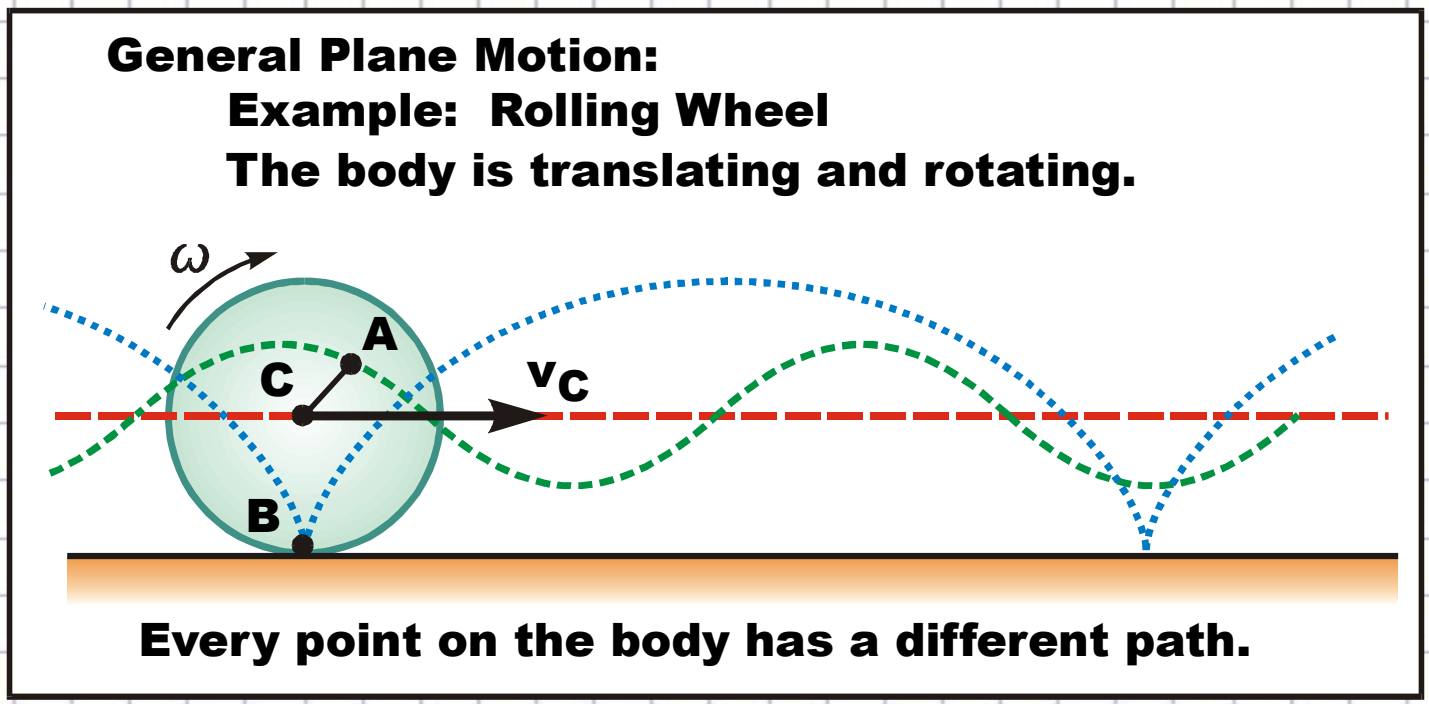


All points at the same radius have equal velocity and acceleration magnitudes.

Center, O, is fixed. Has a zero velocity.

Types of Rigid Body Planar Motion (cont'd)

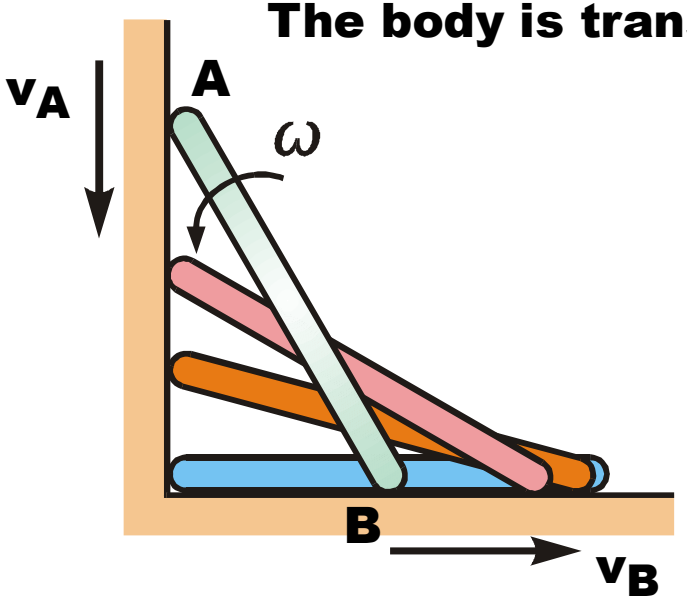
General Plane Motion: The body translates *and* rotates. Each point moves along a different path and thus each has a different velocity vector.



Types of Rigid Body Planar Motion (cont'd)

Another example of general plane motion:
Bar Sliding Down Wall. It translates and rotates.

General Plane Motion:
Example: Bar sliding down wall
The body is translating and rotating.

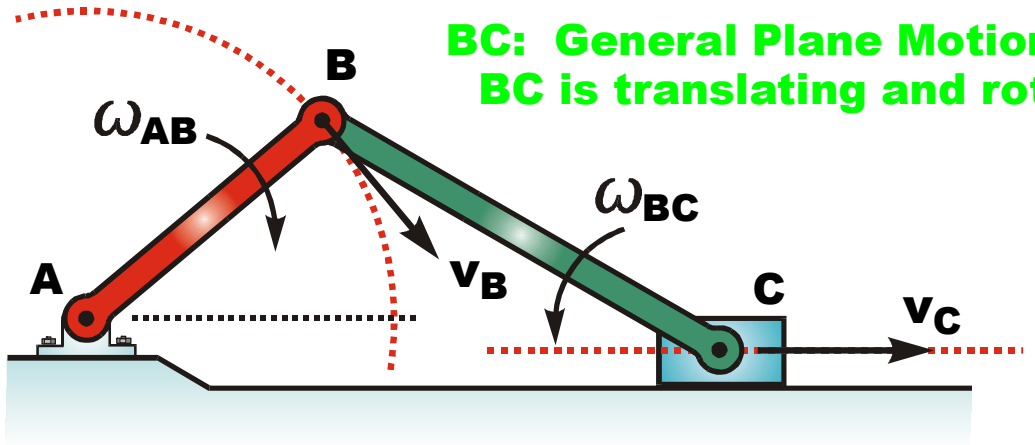


Types of Rigid Body Planar Motion (cont'd)

Slider-Crank Mechanism:

This common mechanism (AB is the "crank", C is the slider, and BC is the connecting rod) illustrates all three motions: FA Rotation, Gen Plane, and Translation.

Example: "Slider Crank" Mechanism
Illustrates all three motions...



BC: General Plane Motion:
BC is translating and rotating.

Link AB: Fixed Axis Rotation
Pin B moves in a circle around a fixed pin at A.

Slider C is translating only.