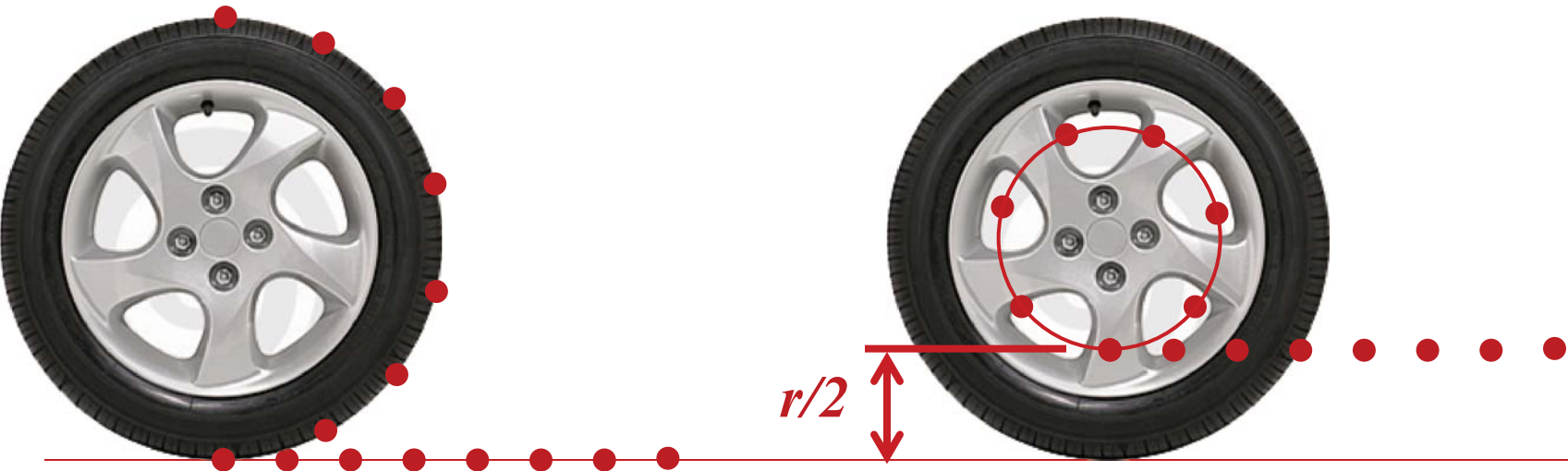# Instantaneous Center of Zero Velocity
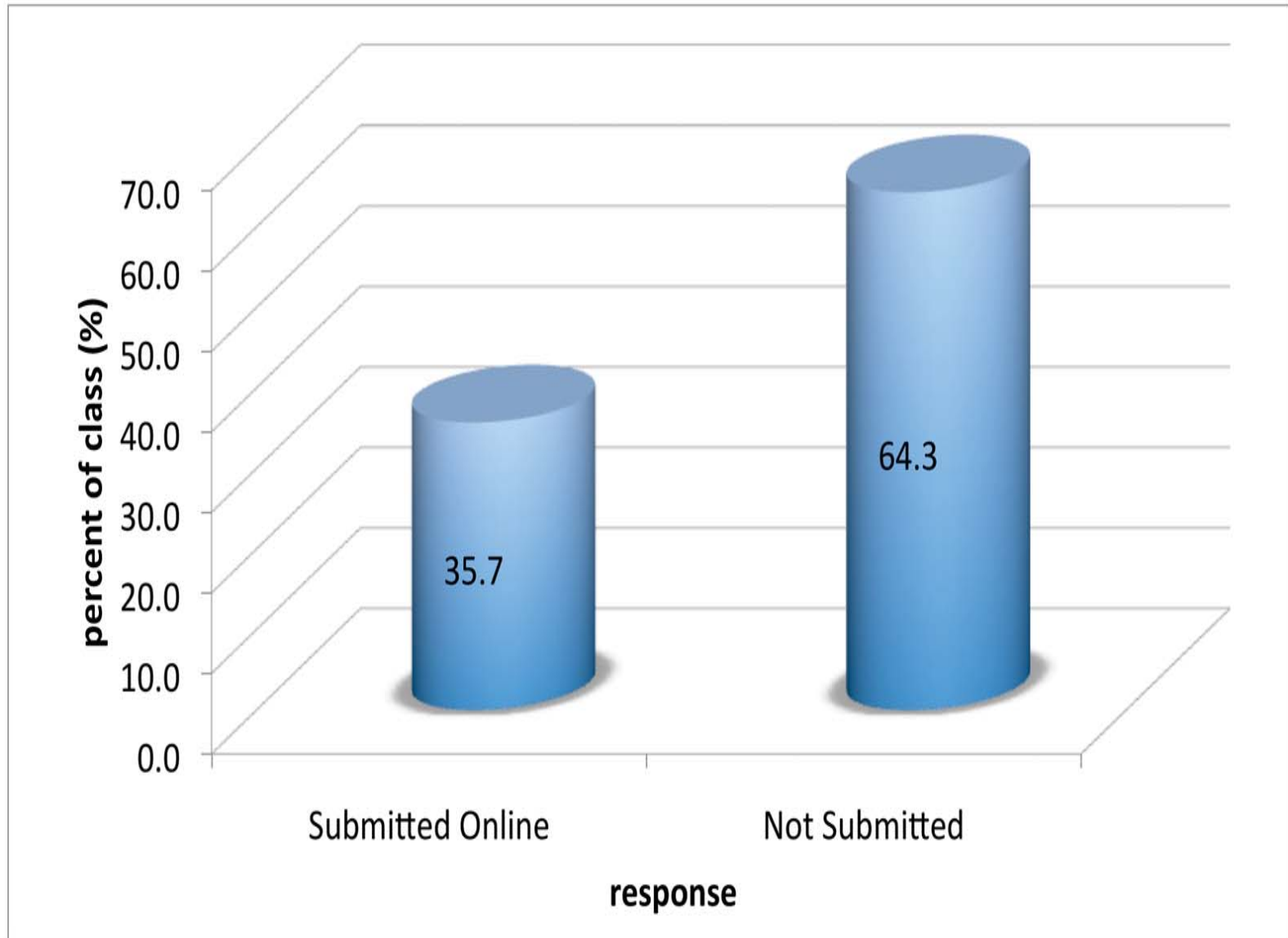## Lecture 12

ME 231: Dynamics

Question of the Day

A wheel of **radius _r_** _rolls without slipping_ and has **velocity** 0.8 in/s and **angular velocity** 1.0 rad/s. What **point(s)** on the wheel has **zero velocity**?

A wheel of **radius _r_** _rolls and slips on ice_ and has the _same_ **velocity** 0.8 in/s but an **angular velocity** 2.0 rad/s. What **point(s)** on the wheel has **zero velocity**?

_r/2_

Admin: Course Feedback

Outline for Today

- Question of the day
- Instantaneous axis and center
- Locating the instantaneous center
- Motion of the instantaneous center
- Answer your questions!

Instantaneous Axis and Center of Zero Velocity

- Reference *point O* momentarily has *zero velocity*

- Pure rotation occurs about an *instantaneous axis* normal to the plane of motion

- Intersection of this *axis* with the plane of motion is the *instantaneous center*
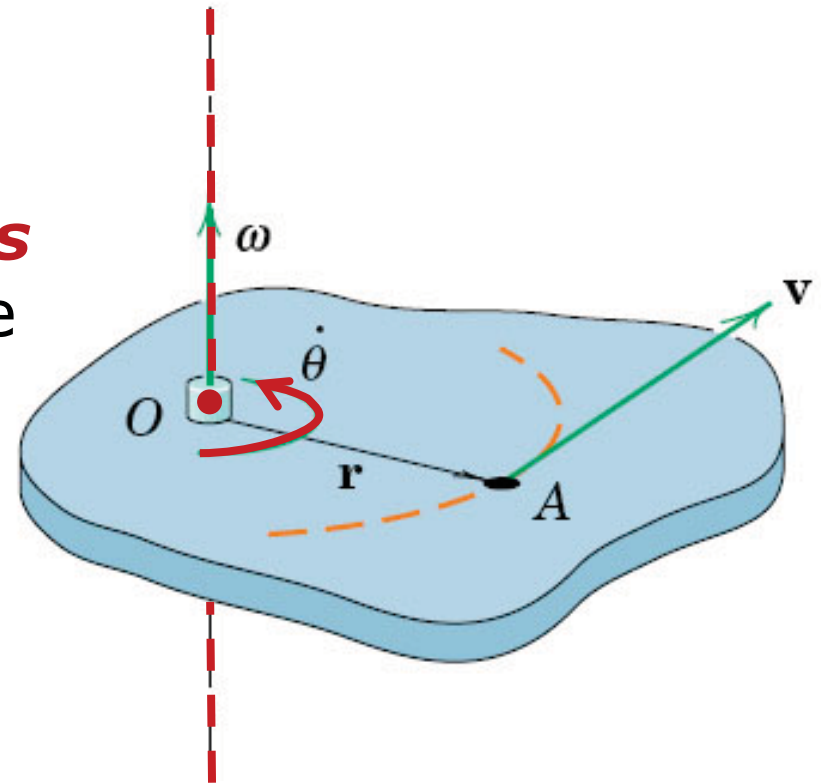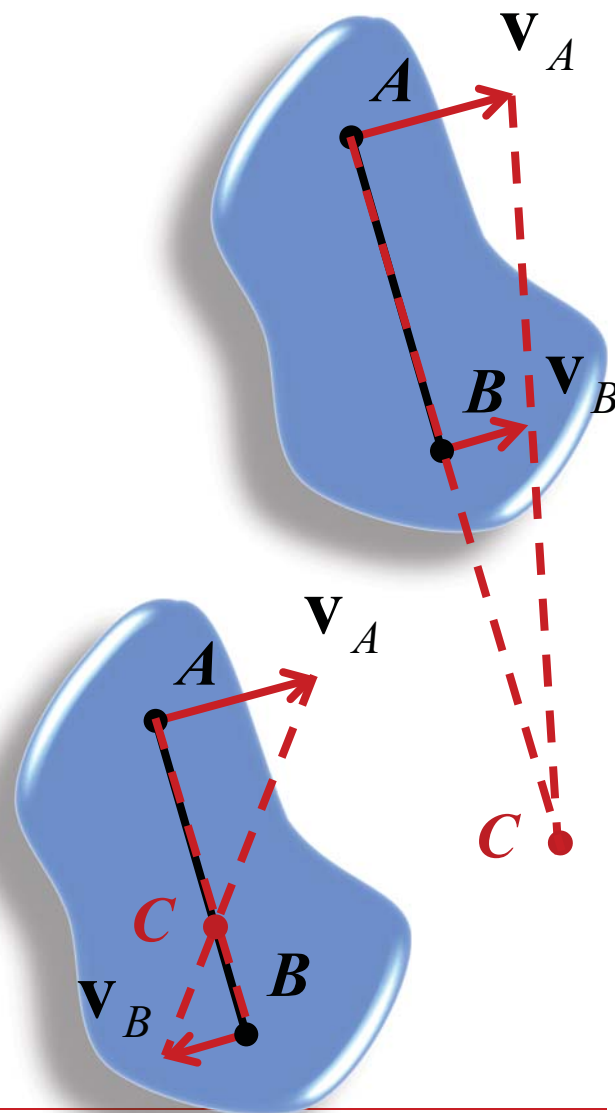
Locating the Instantaneous Center: Case #1

- Directions of absolute **velocities** for A and B are known (*and not parallel*)

- **Point A** has circular motion about some point on the **line perpendicular** to **velocity** $\mathbf{v}_A$

- **Point B** has a **similar** motion

- **Point C** is the **instantaneous center** of zero velocity (*may lie on or off the body*)
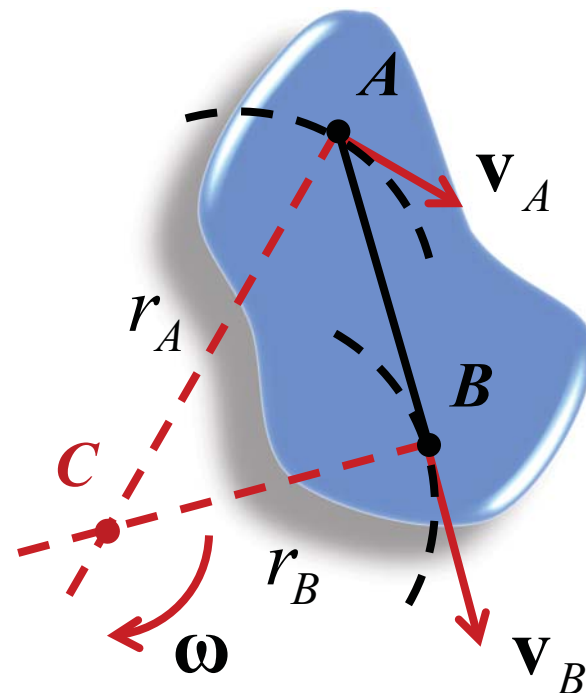
$$\omega = \frac{v_A}{r_A} = \frac{v_B}{r_B}$$
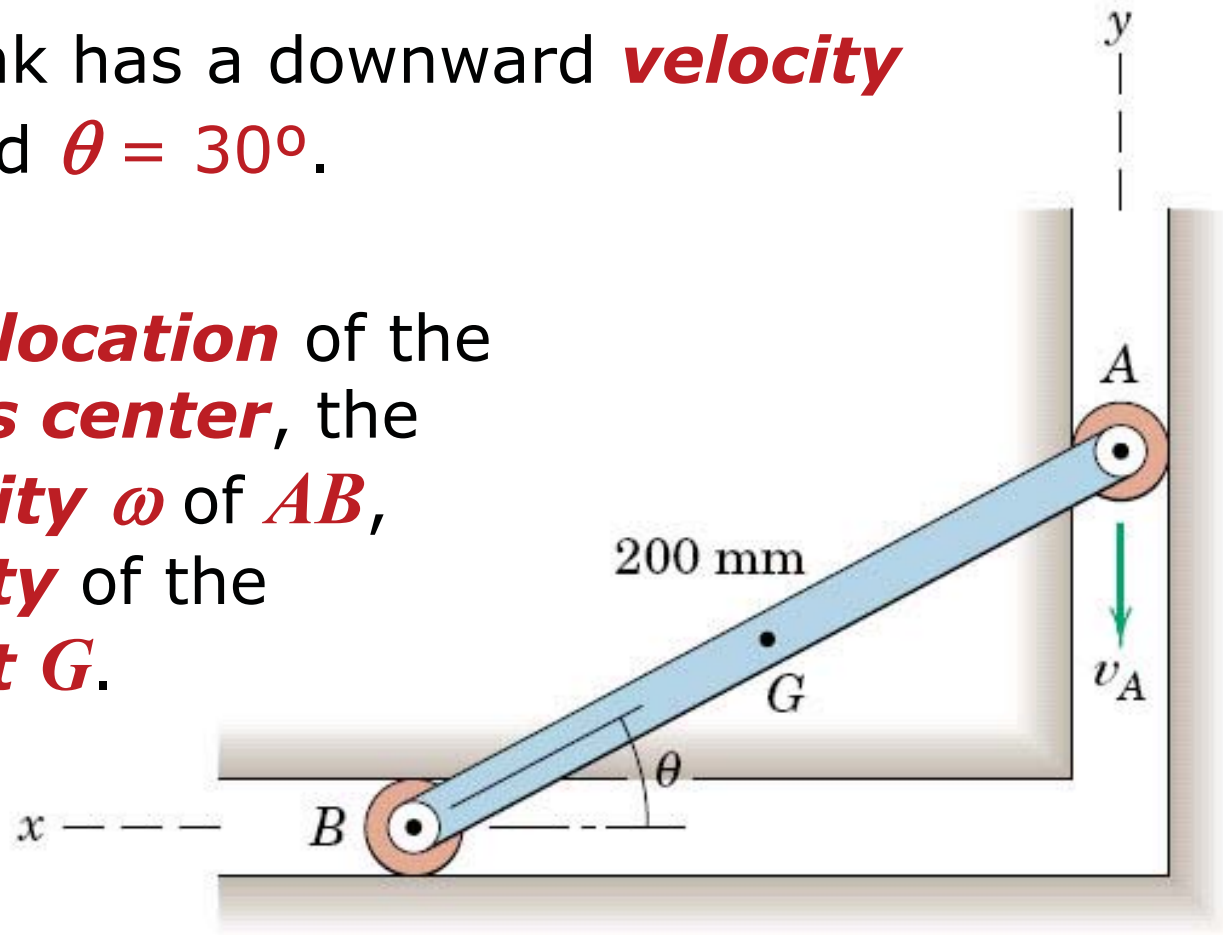
Locating the Instantaneous Center: Case #2

- Directions of absolute *velocities* for A and B are known AND *parallel*
- The *line* joining the points is *perpendicular* to *velocity* $\mathbf{v}_A$ and $\mathbf{v}_B$
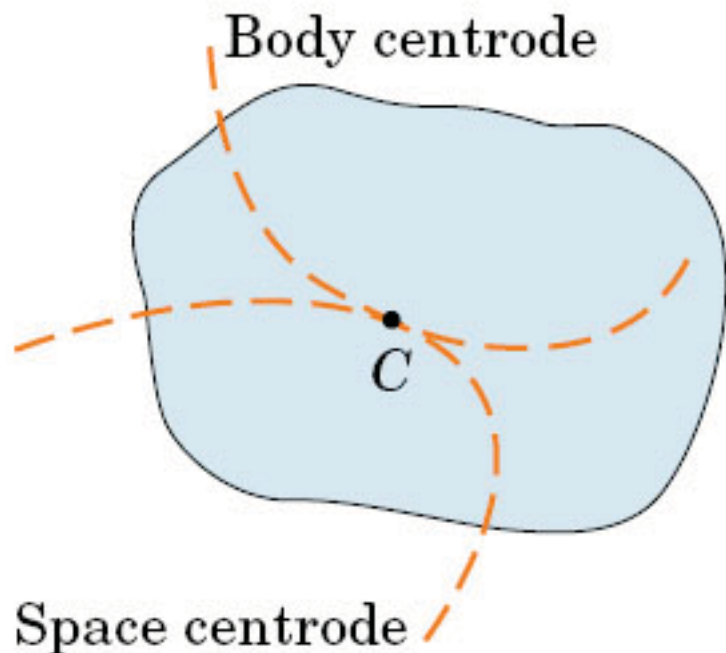- *Instantaneous center* found by *direct proportions*

Instantaneous Center: Exercise

End A of the link has a downward **velocity** $\mathbf{v}_A$ = 2 m/s. and θ = 30º.

Determine the **location** of the **instantaneous center**, the **angular velocity** ω of AB, and the **velocity** of the link's **midpoint G**.

200 mm

Motion of the Instantaneous Center

Body centrode

C

Space centrode

- As a **body** changes **position** the **instantaneous center** changes **position**

- Locus of **instantaneous center** positions in **space** is the **space centrode**

- Locus of **instantaneous center** positions on the **body** is the **body centrode**

C

Instantaneous Center: Another Exercise

The rear wheel of a car moving to the right has a diameter of 26" and an ***angular speed N*** of 200 rev/min on an icy road. The **instantaneous center** of zero velocity is 4" above the point of contact with the road.

26"

N
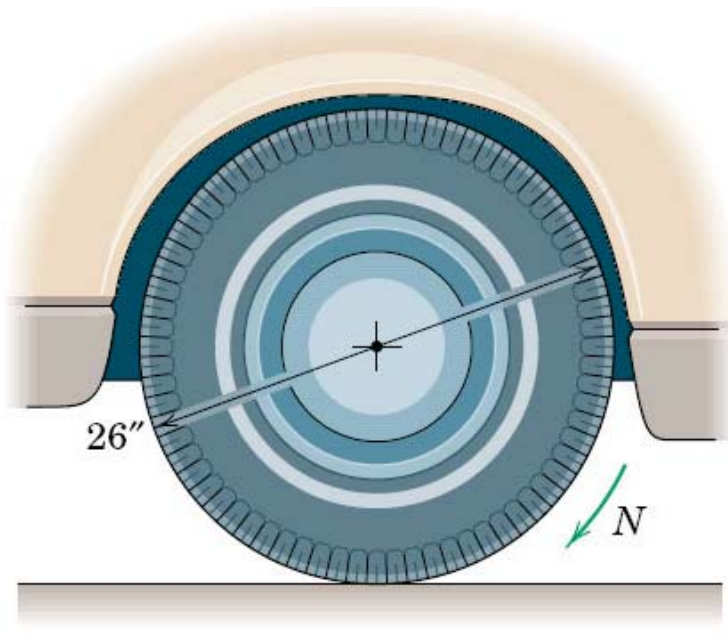
Determine the ***velocity v*** of the car and the ***slipping velocity*** v_s of the tire on the ice.

Outline for Today

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For Next Time...

- Begin Homework #5 due next week (9/26)
- Read Chapter 6, Section 6.3