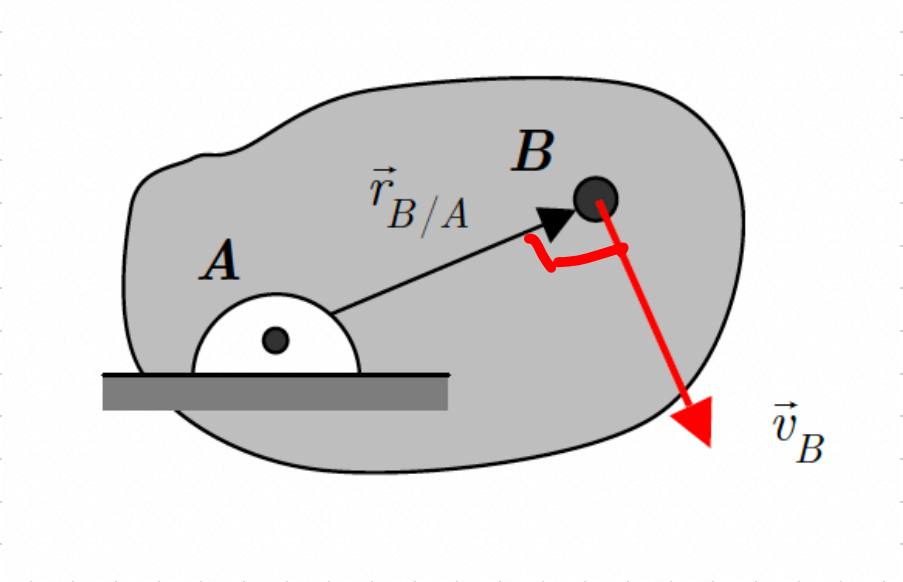
Instant Center of rotation.

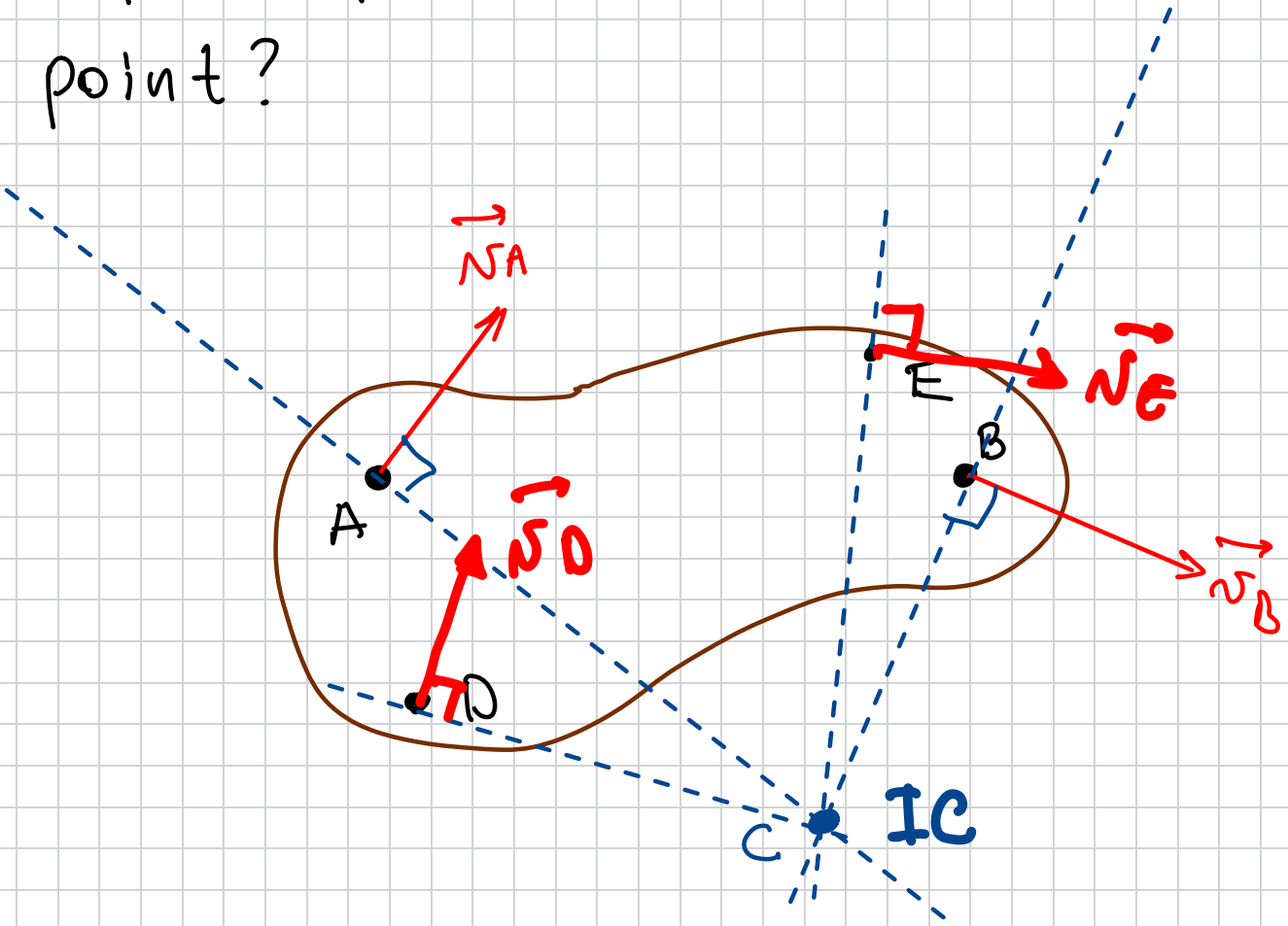
2/2/2026

Remember the simple rotation of a rigid body about a fixed point:



In this simple case, A is the "center of rotation" of the rigid body. As such, we intuitively know the direction of, and can calculate the magnitude of the velocity of some pt. B.

What happens if we do not have an explicit fixed point?



Turns out that at any instant, the body's movement can be considered as a pure rotation about C (the Instant Center of Rotation). The ICR need not be in the body

How do I find the ICR?

1) Find two points with defined $\vec{v}$ directions
2) Draw lines perpendicular to each $\vec{v}$ passing through each point
3) Mark the ICR @ the intersection of the two lines.

What is it useful for?

1) $\vec{v}_{ICR} = 0$ (fixed point). Any point within the body with $\vec{v} = 0$ is an ICR.

2) $|\vec{v}_P| = |\vec{r}_{P/ICR}| \cdot \omega$ (points farther away from ICR have higher speed)

3) All $\vec{v}$ are rotating in same direction @ ICR

The speed of any point is proportional to the distance $\overline{CP}$ $(C = IC)$

$$|\vec{v}_A| = \omega |\vec{r}_{A/C}|, \quad |\vec{v}_B| = \omega |\vec{r}_{B/C}|, \quad \dots \quad |\vec{v}_G| = \omega |\vec{r}_{G/C}|$$

Limitations of ICR

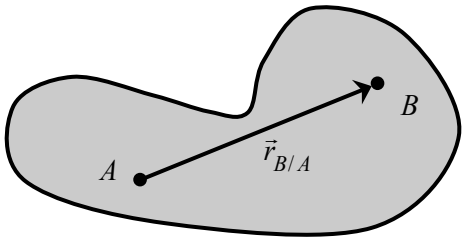
- Purely geometric method
- Not suitable for acceleration, just velocities.

Summary: Rigid Body Kinematics 4

PROBLEM: Two points A and B on the same rigid body undergoing planar motion.

$$\vec{v}_B = \vec{v}_A + \vec{\omega} \times \vec{r}_{B/A}$$

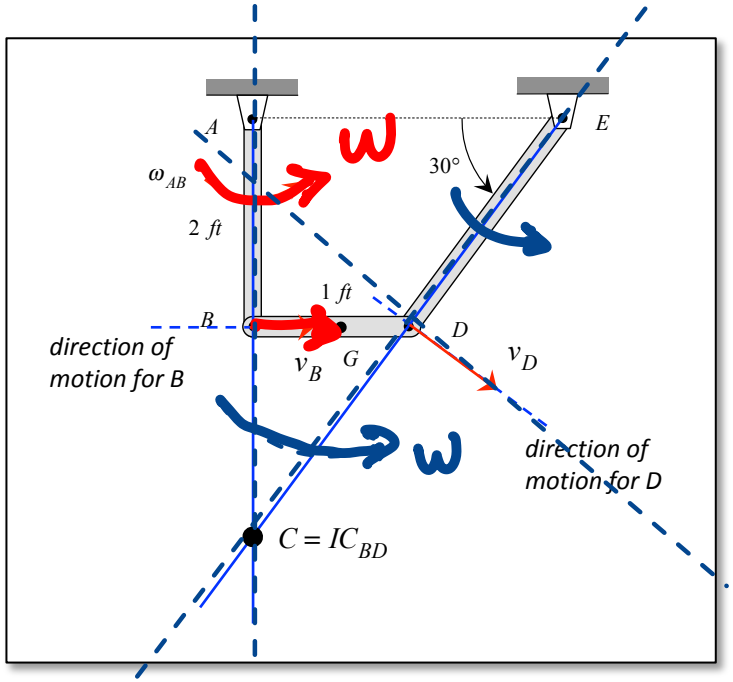
$$\vec{a}_B = \vec{a}_A + \vec{\alpha} \times \vec{r}_{B/A} - \omega^2 \vec{r}_{B/A}$$



SPECIAL TOPIC: "Instant center of rotation"

The "center of rotation" (instant center) for a body is located at the intersection of the perpendiculars to the velocities of two points on the body.

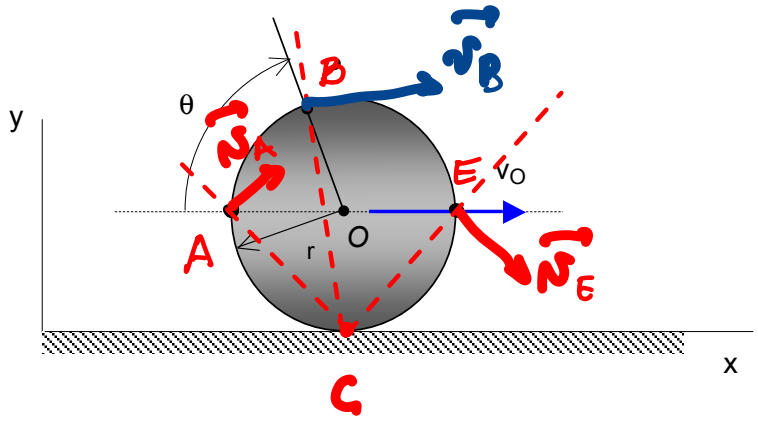
- The velocity of a point G on a link is perpendicular to the line connecting G and and the instant center C.
- The speed of G is equal to the angular speed of the link times the distance from C to G.
- Where is the IC when the perpendiculars are parallel to each other?



Example 2.A.5

Given: A wheel rolls without slipping on a rough horizontal surface. At one instant, when $\theta = 90°$, the center of the wheel O is moving to the right with a speed of $v_O = 5$ ft/s with this speed decreasing at a rate of 3 ft/s^2.

Find: Determine the acceleration of point P on the circumference of the wheel at this instant, if $r = 2$ ft. Make a sketch of this acceleration vector at P.



C = IC (zero velocity on body)

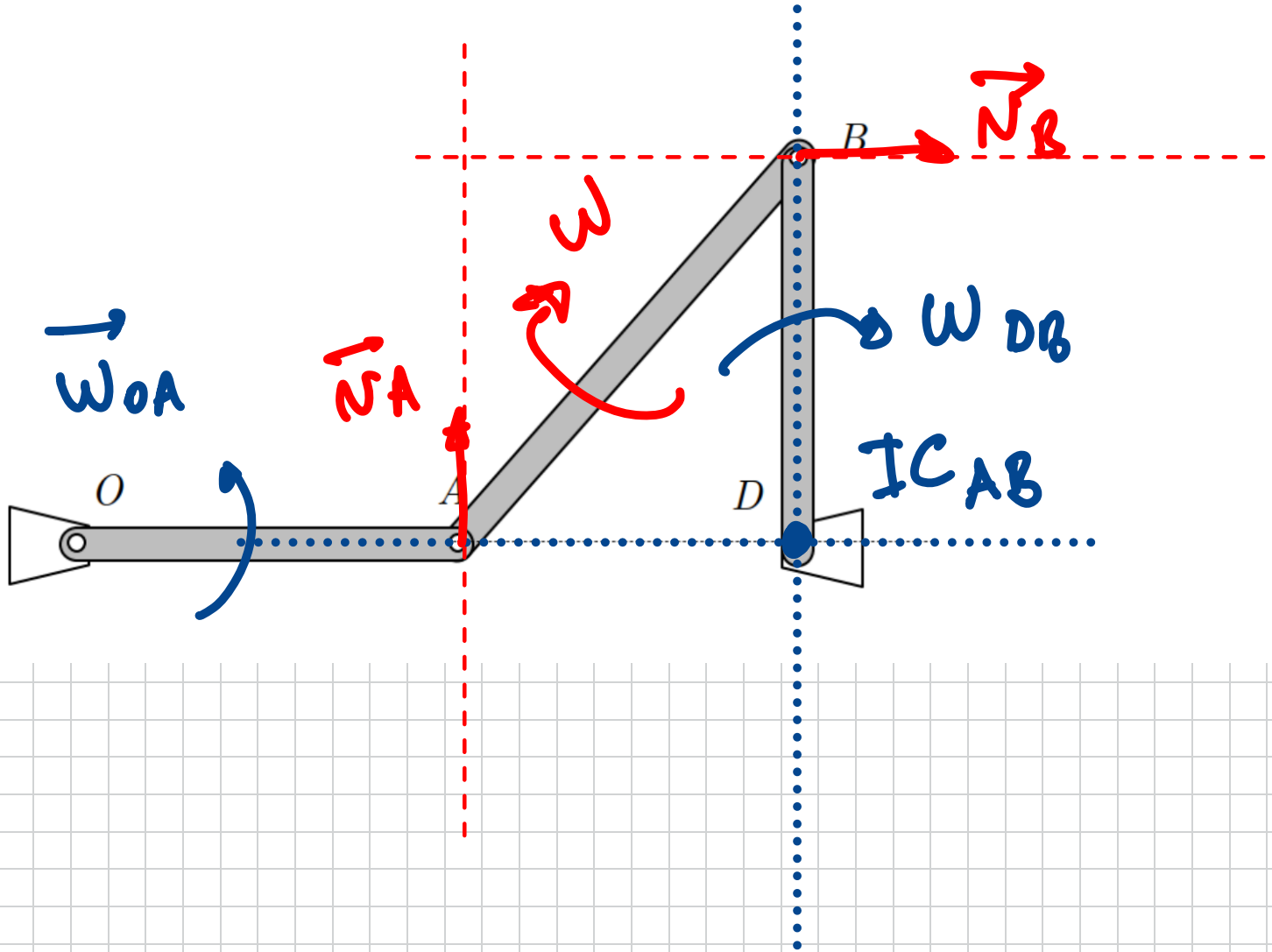
- $\vec{v}_A \perp \overline{AC}$
  $\vec{v}_B \perp \overline{BC}$
  $\vec{v}_E \perp \overline{EC}$

- $v_A = \overline{AC} \cdot \omega$
  $v_B = \overline{BC} \cdot \omega$
  $v_E = \overline{EC} \cdot \omega$

- $\vec{v}_B > \vec{v}_A$
  $\vec{v}_B > \vec{v}_E$
  $\vec{v}_E = \vec{v}_A$

Example:

If AB is rotating clockwise, what is the rotation direction other other members in the system shown below?



Example:

If AB rotating clockwise, what is the rotation direction of other members in the system shown below?