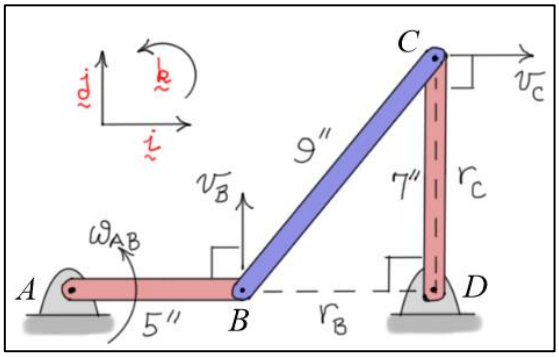
Elementary Dynamics Example #34b: (Rigid Body Kinematics – Instantaneous Centers)

Given: four-bar mechanism *ABCD*

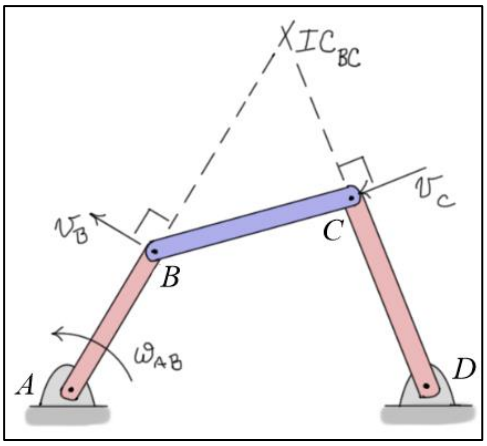
$\omega_{AB} = 5$ (r/s)

Find: ω_{BC}, ω_{CD}



Solution:

Consider the general four-bar mechanism shown in the second diagram. To find the instantaneous center (IC) of the connecting link *BC*, construct lines that are perpendicular to the velocities of both *B* and *C*. These lines which are along the links *AB* and *CD* intersect at the IC of link *BC*.



General Configuration

Using this approach on the given four-bar mechanism, the IC of the connecting link *BC* is found to be at point *D* at the instant shown. Using this observation, write

$$\boxed{v_B = r_{AB}\,\omega_{AB} = r_B\,\omega_{BC}} \quad \Rightarrow \boxed{\omega_{BC} = \left(\frac{r_{AB}}{r_B}\right)\omega_{AB} = \left(\frac{5}{\sqrt{9^2-7^2}}\right)5 = 4.41942 \approx 4.42 \text{ (r/s)}}$$

$$\boxed{v_C = r_C\,\omega_{BC} = r_C\,\omega_{CD}} \quad \Rightarrow \boxed{\omega_{CD} = \left(\frac{r_C}{r_C}\right)\omega_{BC} \approx 4.42 \text{ (r/s)}}$$

Given the velocity of *B* is upward, the velocity of *C* must be to the right. Hence, the angular velocities of links *BC* and *CD* must both be clockwise. So, at the instant shown,

$$\boxed{\underset{\sim}{\omega}_{BC} = \underset{\sim}{\omega}_{CD} = -4.42\,\underset{\sim}{k} \text{ (r/s)}}$$