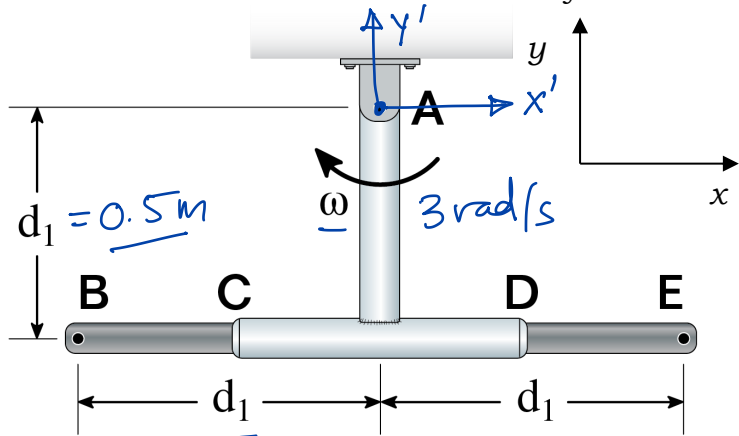


**Problem 1 [20 Marks]** Body ACD is pinned at A and is rotating with an angular velocity of  $\omega = 3 \text{ rad/s}$  (as shown) at this instant. Bar BE slides through tube CD, such that, at this instant, the velocity of B is purely in the  $\hat{j}$ -direction, and the acceleration of B is zero (as observed from the fixed frame). Find the vectors for the velocity and acceleration of B in the rotating frame,  $(\vec{v}_{B/A})_{x'y'z'}$  and  $(\vec{a}_{B/A})_{x'y'z'}$ , and the angular acceleration of ACD,  $\vec{\alpha}$ , at this instant. Distance  $d_1 = 0.5 \text{ m}$ . [Reminder – include vector directions and units in your answer].



Known:  $(\vec{v}_{B/A})_{x'y'z'} = (\vec{v}_{B/A})_{rel}$

$(\vec{v}_{B/A})_{x'y'z'}$  in x-dir only

$(\vec{a}_{B/A})_{x'y'z'}$  in x-dir only

$\vec{\omega} = -3 \text{ rad/s } \hat{k}$

$\vec{r}_{B/A} = -0.5\hat{i} - 0.5\hat{j}$

$\vec{v}_B = v_B \hat{j}$

$\vec{a}_B = 0$

$$\vec{v}_B = \vec{v}_A + \vec{\omega} \times \vec{r}_{B/A} + (\vec{v}_{B/A})_{x'y'z'}$$

$$v_B \hat{j} = -3\hat{k} \times (-0.5\hat{i} - 0.5\hat{j}) + (v_{B/A})_{x'y'z'} \hat{i}$$

$$v_B \hat{j} = 1.5\hat{j} - 1.5\hat{i} + (v_{B/A})_{x'y'z'} \hat{i}$$

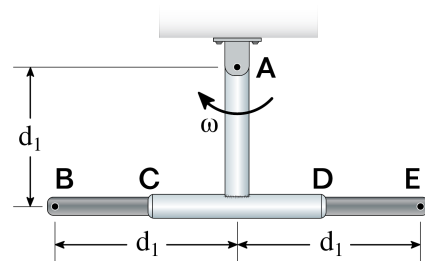
Components:

$$\hat{i}: 0 = -1.5 + (v_{B/A})_{x'y'z'} \rightarrow (\vec{v}_{B/A})_{x'y'z'} = 1.5 \text{ m/s } \hat{i}$$

$$\hat{j}: v_B = 1.5$$

$$\vec{v}_B = 1.5 \text{ m/s } \hat{j}$$

Problem 1 continued



$$\cancel{4.5} + \cancel{4.5} + (a_{B/A})_{x'y'z'}$$

$$\boxed{(a_{B/A})_{x'y'z'} = 0}$$