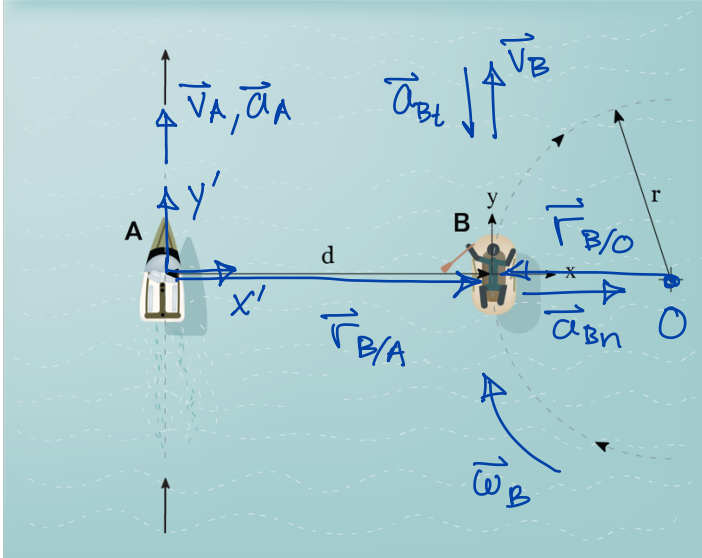


Boat A is travelling forward (in positive y) with a velocity of 25 m/s and an acceleration of 4 m/s². The person in dingy B is travelling in a circle (as they only have one oar). They have a forward (in positive y) velocity of 5 m/s and acceleration of -1 m/s² (as they have lost focus while watching boat A). The radius of dingy B's path is r = 20 m, and the distance between the vessels is d = 10 m.

Find the velocity and acceleration of dingy B as seen by the occupants of boat A.



Find $(\vec{v}_{B/A})_{rel}$ & $(\vec{a}_{B/A})_{rel}$

$$\vec{\omega} = 0$$

$$\dot{\vec{\omega}} = 0$$

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

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

$$(\vec{v}_{B/A})_{rel} = \vec{v}_B - \vec{v}_A = 5 \text{ m/s } \hat{j} - 25 \text{ m/s } \hat{j}$$

$$\boxed{(\vec{v}_{B/A})_{rel} = -20 \text{ m/s } \hat{j}}$$

$$\vec{a}_B = \vec{a}_A + \dot{\vec{\omega}} \times \vec{r}_{B/A} - \vec{\omega} \times \vec{r}_{B/A} + 2\vec{\omega} \times (\vec{v}_{B/A})_{rel} + (\vec{a}_{B/A})_{rel}$$

$$(\vec{a}_{B/A})_{rel} = \vec{a}_B - \vec{a}_A$$

$$\vec{a}_B = \vec{a}_{Bt} + \vec{a}_{Bn} = -1 \text{ m/s}^2 \hat{j} + \overbrace{\omega_B^2 r}^{1.25} \hat{i}$$

$$(\vec{a}_{B/A})_{rel} = (-1 \hat{j} + 1.25 \hat{i}) - 4 \hat{j}$$

$$\vec{v}_B = \vec{v}_O + \vec{\omega}_B \times \vec{r}_{B/O}$$

$$v_B \hat{j} = -\omega_B \hat{k} \times (-r \hat{i})$$

$$v_B \hat{j} = \omega_B r \hat{j} \Rightarrow \omega_B = \frac{v_B}{r} = 0.25 \text{ rad/s}$$

$$\boxed{(\vec{a}_{B/A})_{rel} = (1.25 \hat{i} - 5 \hat{j}) \text{ m/s}^2}$$