CH3 #59

RELATIVE VECTOR VELOCITY:

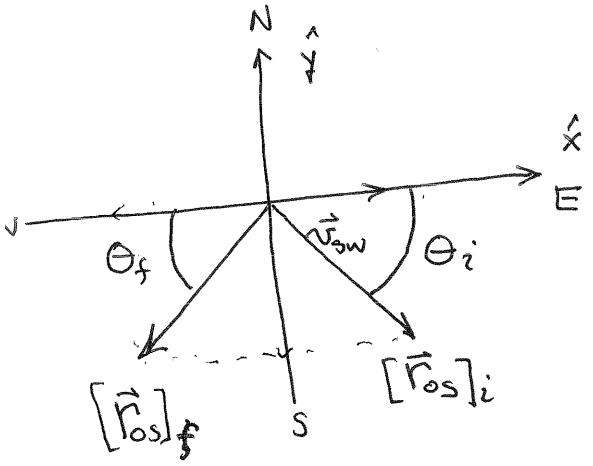
$\vec{v}_{os} \equiv$ Velocity of Object Relative to Ship

$\vec{v}_{sw} \equiv$ Velocity of Ship Relative to water

$\vec{v}_{ow} \equiv$ Velocity of Object Relative to water

FIND $\vec{v}_{ow}$ => $\vec{v}_{ow} = \vec{v}_{os} + \vec{v}_{sw}$

$\vec{v}_{sw}$ = Given = 4.2 m/s EAST => $\vec{v}_{sw} = 4.2 \text{ m/s}\ \hat{x}$



$$\vec{v}_{os} = \frac{[\vec{r}_{os}]_f - [\vec{r}_{os}]_i}{\Delta t} = \frac{\Delta \vec{r}}{\Delta t}$$

$|[\vec{r}_{os}]_i| = 2310 \text{ m} \quad \theta_i = 32°$

$|[\vec{r}_{os}]_f| = 1120 \text{ m}$

We are not given $\vec{v}_{os}$, we are given to Position Vectors for the object and a time interval

=> CALCULATE $\vec{v}_{os}$ FROM DEFINITION OF AVG. Velocity Vector (see ABOVE).

Resolve INITIAL AND FINAL Position vectors INTO COMPONENTS AND PERFORM Vector SUBTRACTION to calculate $\Delta \vec{r}_{os}$

$$[\vec{r}_{os}]_f = [[r_{os}]_{f_x} \overset{x}{,} [r_{os}]_{f_y} \overset{y}{]}$$

$$[\vec{r}_{os}]_f = [-1120m \cos 57^\circ_m, -1120m \sin 57^\circ_m]$$

$$\boxed{[\vec{r}_{os}]_f = [-610m, -939m]}$$

$$[\vec{r}_{os}]_i = [+2310 \cos 32^\circ_m, -2310 \sin 32^\circ_m]$$

$$\boxed{[\vec{r}_{os}]_i = [+1959m, -1224m]}$$

$$\Delta \vec{r}_{os} = [\vec{r}_{os}]_i - [\vec{r}_{os}]_f$$

$[\vec{r}_{os}]_f$ $[-610m, -939m]$

$-$ $[\vec{r}_{os}]_i$ $[-256g\,m, -1224m]$

$\Delta\vec{r}_{os}$ $[-256g\,m, \quad 285m]$

$\Delta t = 6\,min = 360\,s$

$$\vec{v}_{os} = \frac{\Delta\vec{r}_{os}}{\Delta t} = \left[\frac{-256g\,m}{360s}, \frac{285m}{360s}\right]$$

$$\vec{v}_{os} = [-7.1\,m/s, \; +0.79\,m/s]$$

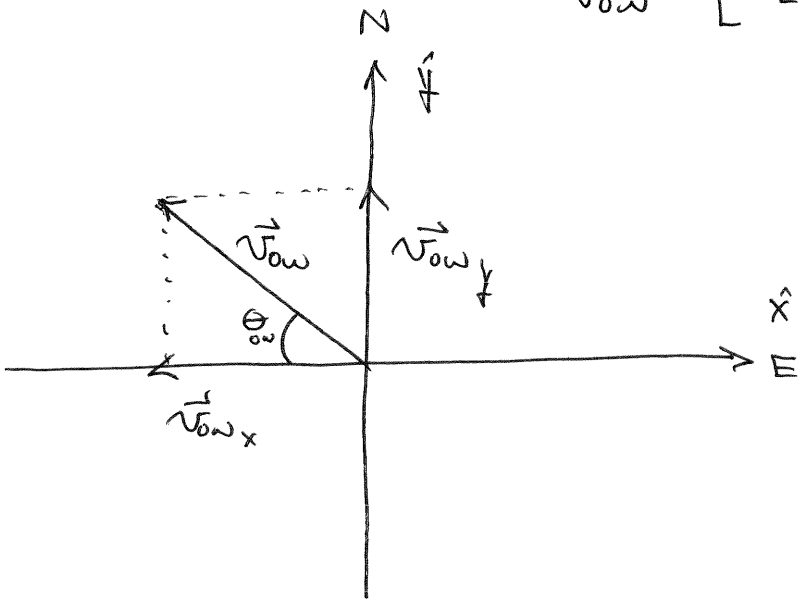
$$\vec{v}_{ow} = \vec{v}_{os} + \vec{v}_{sw}$$

$\vec{v}_{os}$ $[-7.1\,m/s, +0.79\,m/s]$

$+$ $\vec{v}_{sw}$ $[+4.2\,m/s, \quad 0]$

$\vec{v}_{ow}$ $[-2.9\,m/s, +0.79\,m/s]$

$$\vec{v}_{ow} = [-2.9\ m/s,\ 0.79\ m/s]$$



$$|\vec{v}_{ow}| = \sqrt{v_{ow_x}^2 + v_{ow_y}^2} = \left[(-2.9\ m/s)^2 + (0.79\ m/s)^2\right]^{1/2}$$

$$\boxed{|\vec{v}_{ow}| = 3.0\ m/s}$$

$$\theta_{ow} = \tan^{-1}\frac{|v_{ow_y}|}{|v_{ow_x}|}$$

θ_{ow} is in Degrees

NORTH OF WEST

$$\theta_{ow} = \tan^{-1}\frac{0.79\ m/s}{2.9\ m/s} = 15.2^\circ \text{ NORTH OF WEST}$$