

# 3108 - HW1

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1) Given:  $V_B^E \leftarrow$  inertial velocity of aircraft  
in body coordinates

$V_W^B \leftarrow$  air relative velocity of aircraft  
in wind ~~body~~ coordinates

$W_E^E \leftarrow$  velocity of wind in the  
inertial ~~body~~ coordinates

$R_W^B \leftarrow$  rotation matrix from wind frame  
to body ~~body~~ frame

$R_B^E \leftarrow$  rotation matrix from the body  
frame to inertial frame

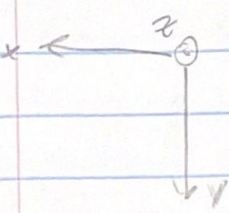
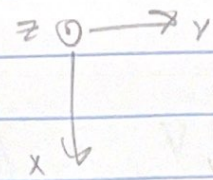
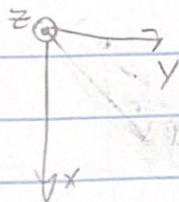
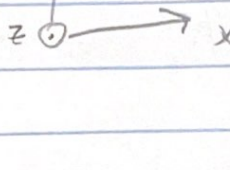
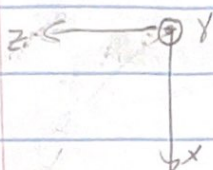
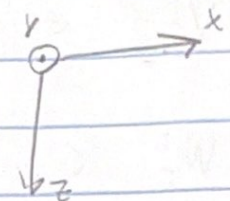
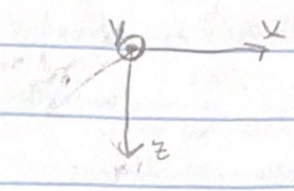
$$V_W^I = V_B^I + W_E^I$$

$$R_B^E R_W^B V_W = R_B^E V_B^E + W_E^E$$

2)

$P_1$

$P_2$



not the  
same  
attitude

False



3)

$$\mathbf{V}_B^E = \langle 21, 0, -3 \rangle \text{ m/s}$$

$$\begin{pmatrix} \phi \\ \theta \\ \psi \end{pmatrix} = \begin{pmatrix} -12 \\ -1 \\ 221 \end{pmatrix}^\circ$$

find  $R_B^E$ 

$$R_B^E = [R_B^E]^T = \begin{pmatrix} 1 & 0 & 0 & \cos\theta & 0 & \sin\theta \\ 0 & \cos\phi & -\sin\phi & 0 & 1 & 0 \\ 0 & \sin\phi & \cos\phi & \sin\theta & 0 & \cos\theta \end{pmatrix} \begin{pmatrix} \cos\psi & -\sin\psi & 0 \\ \sin\psi & \cos\psi & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

$$= \begin{pmatrix} \cos\theta \cos\psi & \sin\theta \sin\phi \cos\psi - \cos\phi \sin\psi & \cos\phi \sin\theta \cos\psi - \sin\phi \sin\psi \\ \cos\theta \sin\psi & \sin\theta \sin\phi \sin\psi - \cos\phi \cos\psi & \cos\phi \sin\theta \sin\psi - \sin\phi \cos\psi \\ -\sin\theta & \sin\phi \cos\theta & \cos\phi \cos\theta \end{pmatrix}$$

$$= \begin{pmatrix} -0.7529 & 0.05729 & -0.08491 \\ -0.6545 & 0.7287 & -0.1121 \\ 0.0698 & -0.2074 & -0.06823 \end{pmatrix}$$

$$\mathbf{V}_E^E = R_B^E \mathbf{V}_B^E$$

$$\mathbf{V}_E^E = \begin{pmatrix} -15.56 \\ -13.41 \\ 1.67 \end{pmatrix} \text{ m/s}$$