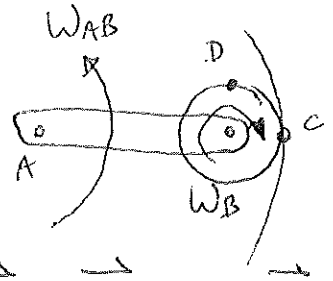
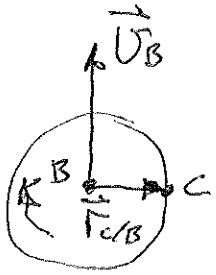
PROB. 15-52



$\omega_{AB} = 20 \frac{RAD}{SEC}$ CCW

a) FIND ω_B



$v_B = r_{AB}\omega_{AB}$

$\vec{v}_C = \vec{v}_B + \vec{v}_{C/B} = \vec{v}_B + (\omega_B)\hat{k} \times \vec{r}_{C/B}$

$0 = (r_{AB}\omega_{AB})\hat{j} + (\omega_B)\hat{k} \times (r_B)\hat{i}$

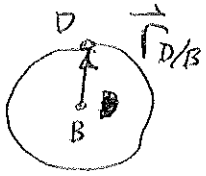
$$(\omega_B)\hat{k} \times (r_B)\hat{i} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & \omega_B \\ r_B & 0 & 0 \end{vmatrix}$$

$= -[0 - (\omega_B)(r_B)]\hat{j} = (r_B\omega_B)\hat{j}$

$0 = r_{AB}\omega_{AB} + r_B\omega_B$

$\omega_B = -\left(\frac{r_{AB}}{r_B}\right)\omega_{AB} = -\left(\frac{120}{30}\right)\left(20 \frac{RAD}{SEC}\right) = -48 \frac{RAD}{SEC}\ \hat{k}$

$\vec{v}_D = \vec{v}_B + \vec{v}_{D/B} = \vec{v}_B + (\omega_B)\hat{k} \times \vec{r}_{D/B}$



$(v_{Dx})\hat{i} + (v_{Dy})\hat{j} = (r_{AB}\omega_{AB})\hat{j} + (\omega_B)\hat{k} \times (r_B)\hat{j}$

$$(\omega_B)\hat{k} \times (r_B)\hat{j} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & \omega_B \\ 0 & r_B & 0 \end{vmatrix}$$

$= [0 - (\omega_B)(r_B)]\hat{i} = (-r_B\omega_B)\hat{i}$

PROB. 15-52 CONT.

$$(v_{Dx})\hat{i} + (v_{Dy})\hat{j} = (r_{AB}\omega_{AB})\hat{j} + (-r_B\omega_B)\hat{i}$$

$$v_{Dx} = -r_B\omega_B = -\left(50\ \text{mm}\right)\left(-48\ \frac{\text{RAD}}{\text{SEC}}\right) = 2400\ \frac{\text{mm}}{\text{SEC}}$$

$$v_{Dy} = r_{AB}\omega_{AB} = \left(120\ \text{mm}\right)\left(20\ \frac{\text{RAD}}{\text{SEC}}\right) = 2400\ \frac{\text{mm}}{\text{SEC}}$$

$$v_D = \sqrt{2400^2 + 2400^2} = 3394\ \frac{\text{mm}}{\text{SEC}} \quad \nearrow 45^\circ$$