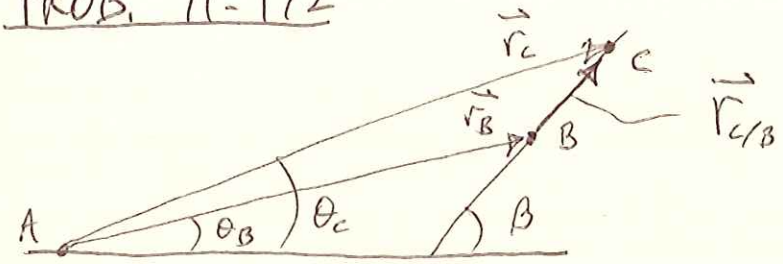
PROB. 11-172



AT B, $r_B = 3000\ ft$, $\theta_B = 20°$

AFTER $t = 4^s$ (POINT C), $r_C = 3320\ ft$, $\theta_C = 23.1°$

FIND v_{AVE} AND β

$$\vec{v} = (\dot{r})\hat{e}_r + (r\dot{\theta})\hat{e}_\theta$$

$$\dot{r} = \frac{dr}{dt} = \frac{r_C - r_B}{\Delta t} = \frac{(3320 - 3000\ ft)}{(4^s)} = 80\ \frac{ft}{s}$$

$$\dot{\theta} = \frac{d\theta}{dt} = \frac{\theta_C - \theta_B}{\Delta t} = \left[\frac{23.1 - 20°}{4^s}\right]\cdot\left(\frac{\pi}{180°}\right) = 0.01353\ \frac{1}{s}$$

$$r = r_{ave} = \frac{1}{2}(r_B + r_C) = \frac{1}{2}(3000 + 3320) = 3160\ ft$$

$$v_{AVE} = |\vec{v}| = \sqrt{(\dot{r})^2 + (r\dot{\theta})^2}$$

$$v_{AVG} = \sqrt{\left(80\ \frac{ft}{s}\right)^2 + \left[(3160\ ft)\left(0.01353\ \frac{1}{s}\right)\right]^2}$$

$$v_{AVE} = \left(90.71\ \frac{ft}{s}\right)\left(\frac{3600\ s}{HR}\right)\left(\frac{mi}{5280\ ft}\right) = 61.85\ \frac{mi}{H}$$

$$\vec{r}_C = \vec{r}_B + \vec{r}_{C/B}, \quad \vec{r}_{C/B} = \vec{r}_C - \vec{r}_B$$

$$\vec{r}_B = (3000\cos 20)\hat{i} + (3000\sin 20)\hat{j}$$

$$\vec{r}_B = (2819)\hat{i} + (1026)\hat{j}\ ft$$

PROB. 11-172 CONT.

$$\vec{r}_C = (3320 \cos 23.1)\hat{i} + (3320 \sin 23.1)\hat{j}$$

$$\vec{r}_C = (3054)\hat{i} + (1302)\hat{j} \text{ ft}$$

$$\vec{r}_{C/B} = (235)\hat{i} + (276)\hat{j} \text{ ft}$$

$$\beta = \tan^{-1}\left(\frac{276}{235}\right) = 49.59°$$