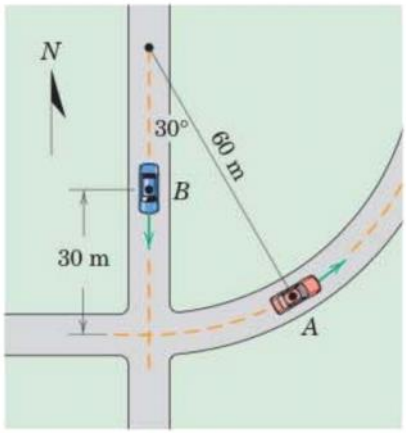
Dynamics Meriam 6ed, 2-243

Wednesday, November 24, 2021 12:32 PM

Car A negotiates a curve of 60-m radius at a constant speed of 50 km/h. When A passes the position shown, car B is 30 m from the intersection and is accelerating south toward the intersection at the rate of 1.5 m/s^2. Determine the acceleration which A appears to have when observed by an occupant of B at this instant.

Ans. $a_{A/B} = 4.58$ m/s^2, $\beta = 20.6°$ west of north



$$v_A = 50 \frac{km}{h} = 50 \times \frac{1000}{3600} = \text{constant}$$

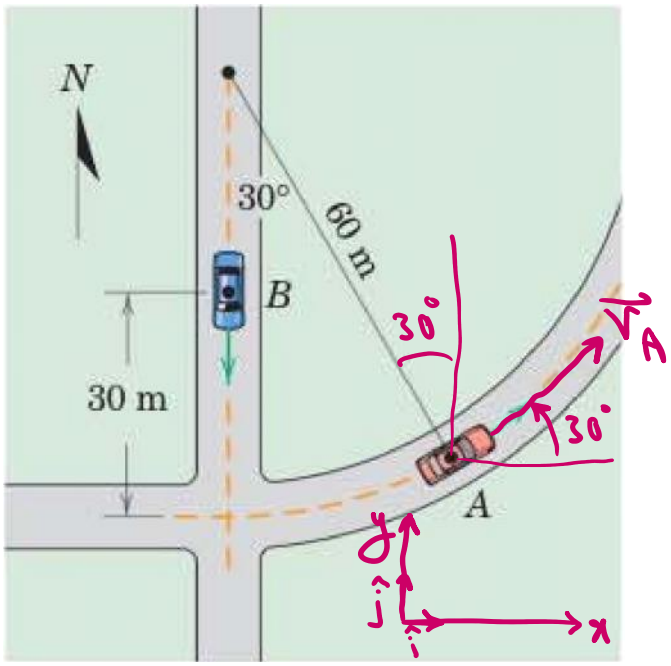
$$\vec{v}_A = 50 \times \frac{1000}{3600} \times (\cos 30\,\hat{i} + \sin 30\,\hat{j})$$

$v_A = \text{constant} \Rightarrow \ddot{\theta} = 0 \Rightarrow$

$$(a_A)_t = 0$$

$$(a_A)_n = \frac{v_A^2}{\rho_A} = \frac{\left(50 \times \frac{1000}{3600}\right)^2}{60} = 3.125 \frac{m}{s^2}$$

$$\vec{a}_B = -1.5\,\hat{j} \ \frac{m}{s^2}$$



$$\vec{a}_A = (a_A)_n \left(-\sin 30\,\hat{i} + \cos 30\,\hat{j}\right)$$

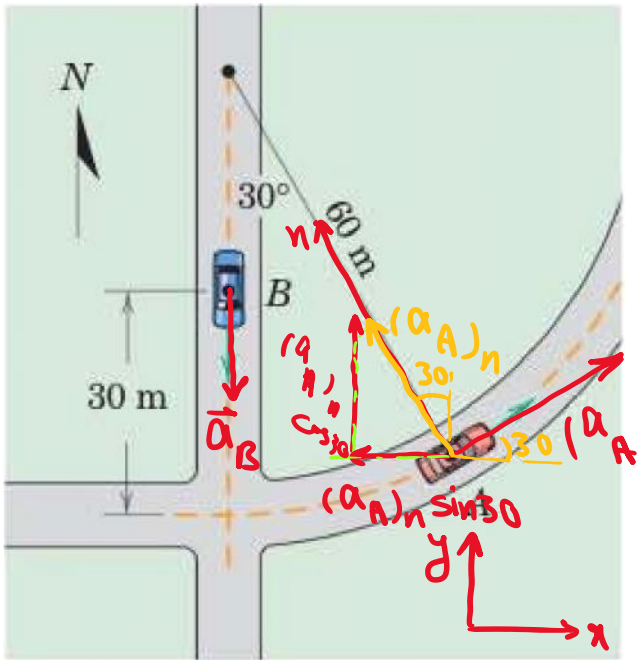
$$= 3.213 \left(-\sin 30\,\hat{i} + \cos 30\,\hat{j}\right)$$

$$= -1.6075\,\hat{i} + 2.7843\,\hat{j} \ \left(\frac{m}{s^2}\right)$$

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

$$= (-1.6075\,\hat{i} + 2.7843\,\hat{j}) - (-1.5\,\hat{j})$$

$$= -1.6075\,\hat{i} + 4.2843\,\hat{j} \ \left(\frac{m}{s^2}\right)$$



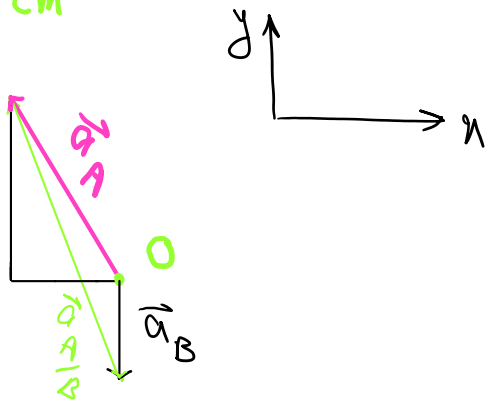
$$a_{A/B} = |\vec{a}_{A/B}| = \sqrt{(-1.6075)^2 + 4.2843^2}$$

$$= 4.5759 \ \frac{m}{s^2}$$

$(a_A)_t = 0 \quad (\ddot{\theta} = 0)$

$\vec{a}_B = -1.5\,\hat{j} \ \frac{m}{s^2}$, $\vec{a}_A = -1.6075\,\hat{i} + 2.7843\,\hat{j} \ \left(\frac{m}{s^2}\right)$

scale $1 \frac{m}{s^2} \equiv 1$ cm



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

$|\vec{a}_{A/B}| \simeq 4.5$ cm $= 4.5 \ \frac{m}{s^2}$