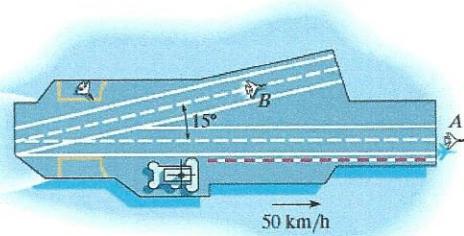


12-225.

An aircraft carrier is traveling forward with a velocity of 50 km/h. At the instant shown, the plane at A has just taken off and has attained a forward horizontal air speed of 200 km/h, measured from still water. If the plane at B is traveling along the runway of the carrier at 175 km/h in the direction shown, determine the velocity of A with respect to B.



SOLUTION

$$\vec{V}_A = \vec{V}_B + \vec{V}_{A/B} \rightarrow$$

$$200 = 50 + 175 \cos 15^\circ + \vec{V}_{A/B}$$

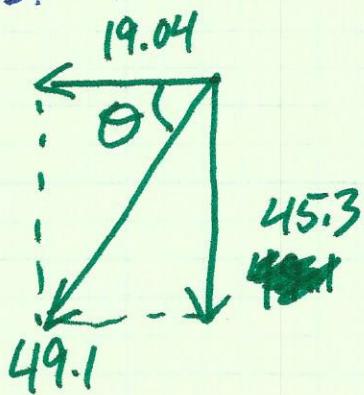
$$x \rightarrow 200 = 50 + 175 \cos 15^\circ + (V_{A/B})_x$$

$$(V_{A/B})_x = -19.04 = 19.04 \text{ km/h} \leftarrow$$

$$y \neq 0 = 0 + 175 \sin 15^\circ + (V_{A/B})_y$$

$$(V_{A/B})_y = -45.3 \text{ km/h} = 45.3 \text{ km/h} \downarrow$$

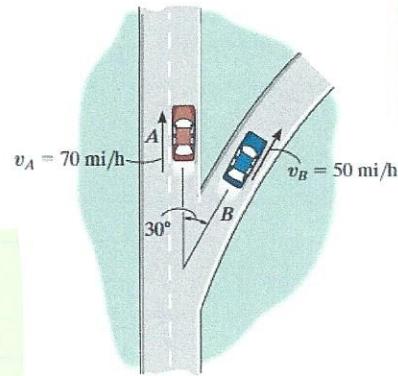
$$|V_{A/B}| = \sqrt{19.04^2 + 45.3^2} = \underline{\underline{49.1 \text{ km/h}}}$$



$$\theta = \tan^{-1} \frac{45.3}{19.04} = \underline{\underline{67.2^\circ}}$$

12-231.

At the instant shown, cars A and B travel at speeds of 70 mi/h and 50 mi/h, respectively. If B is increasing its speed by 1100 mi/h², while A maintains a constant speed, determine the velocity and acceleration of B with respect to A. Car B moves along a curve having a radius of curvature of 0.7 mi.



SOLUTION

$$\vec{V}_B = \vec{V}_A + \vec{V}_{B/A}$$

$\begin{array}{c} 30^\circ \\ \nearrow \end{array} = \uparrow + \vec{V}_{B/A}$

50 mph 70 mph

$$x \rightarrow 50 \sin 30 = 0 + (V_{B/A})_x$$

$$(V_{B/A})_x = 25 \text{ mph} \rightarrow$$

$$y \uparrow 50 \cos 30 = 70 + (V_{B/A})_y$$

$$(V_{B/A})_y = -26.7 = 26.7 \text{ mph} \downarrow$$

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

$\begin{array}{c} 1100 \text{ mph}^2 \\ \nearrow 60^\circ \\ 30^\circ \\ 50^2 \\ 0.7 = 3571 \text{ mph}^2 \end{array} = 0 + \vec{a}_{B/A}$

$$x \rightarrow 1100 \cos 60 + 3571 \cos 80 = 0 + (a_{B/A})_x$$

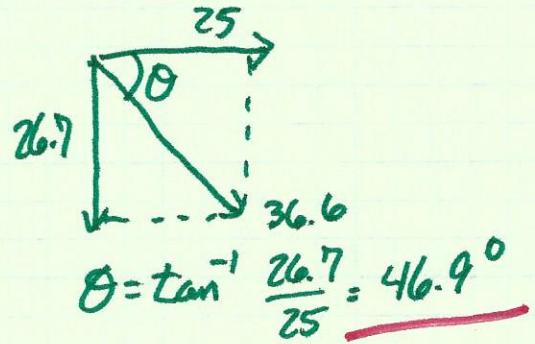
$$(a_{B/A})_x = 3642 \text{ mph}^2 \rightarrow$$

$$y \uparrow 1100 \sin 60 - 3571 \sin 30 = 0 + (a_{B/A})_y$$

$$(a_{B/A})_y = -833 = 833 \text{ mph}^2 \downarrow$$

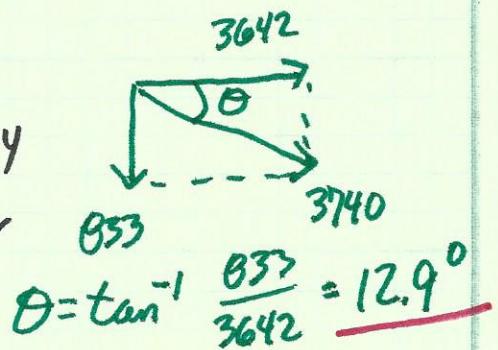
$$|\vec{V}_{B/A}| = \sqrt{25^2 + 26.7^2}$$

$$= 36.6 \text{ mph}$$



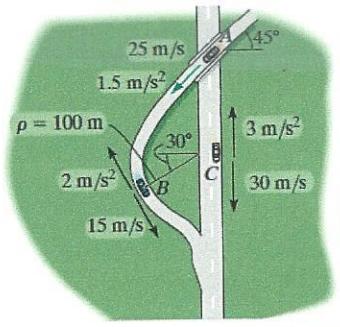
$$|\vec{a}_{B/A}| = \sqrt{3642^2 + 833^2}$$

$$= 3740 \text{ mph}^2$$



*12-236.

Car A travels along a straight road at a speed of 25 m/s while accelerating at 1.5 m/s^2 . At this same instant car C is traveling along the straight road with a speed of 30 m/s while decelerating at 3 m/s^2 . Determine the velocity and acceleration of car A relative to car C.



SOLUTION

$$\vec{V}_A = \vec{V}_C + \vec{V}_{A/C}$$

$\begin{array}{c} 25 \text{ m/s} \\ \swarrow 45^\circ \end{array} = \downarrow + \begin{array}{c} \vec{V}_{A/C} \\ 30 \text{ m/s} \end{array}$

$$x \rightarrow -25 \sin 45 = 0 + (V_{A/C})_x$$

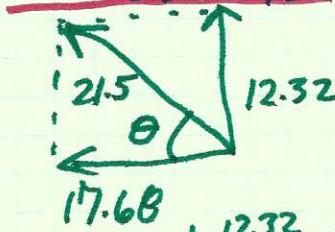
$$(V_{A/C})_x = -17.68 = 17.68 \text{ m/s} \leftarrow$$

$$y \uparrow -25 \cos 45 = -30 + (V_{A/C})_y$$

$$(V_{A/C})_y = 12.32 \text{ m/s} \uparrow$$

$$|\vec{V}_{A/C}| = \sqrt{(-17.68)^2 + 12.32^2}$$

$$= 21.5 \text{ m/s}$$



$$\theta = \tan^{-1} \frac{12.32}{17.68} = 34.9^\circ$$

$$\vec{a}_A = \vec{a}_c + \vec{a}_{A/c}$$

$\begin{array}{c} 1.5 \text{ m/s}^2 \\ \swarrow 45^\circ \end{array} = \uparrow + \begin{array}{c} \vec{a}_{A/c} \\ 3 \text{ m/s}^2 \end{array}$

$$x \rightarrow -1.5 \sin 45 = 0 + (a_{A/c})_x$$

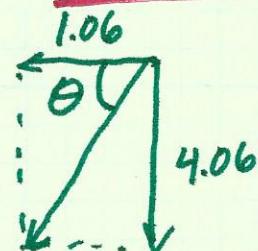
$$(a_{A/c})_x = -1.06 = 1.06 \text{ m/s}^2 \leftarrow$$

$$y \uparrow -1.5 \cos 45 = 3 + (a_{A/c})_y$$

$$(a_{A/c})_y = -4.06 = 4.06 \text{ m/s}^2 \downarrow$$

$$|\vec{a}_{A/c}| = \sqrt{(-1.06)^2 + (4.06)^2}$$

$$= 4.20 \text{ m/s}^2$$



$$\theta = \tan^{-1} \frac{4.06}{1.06}$$

$$= 75.4^\circ$$