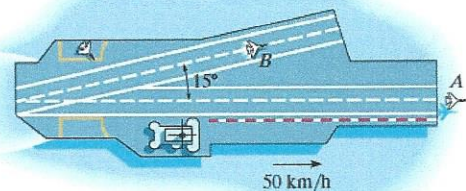


12-225.

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

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

$$\underline{200} \rightarrow = \underline{50} \rightarrow + \nearrow 175 \quad 15^\circ + \vec{V}_{A/B}$$

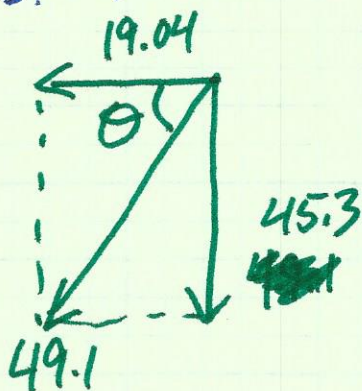
$$x \rightarrow 200 = 50 + 175 \cos 15^\circ + (V_{A/B})_x$$

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

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

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

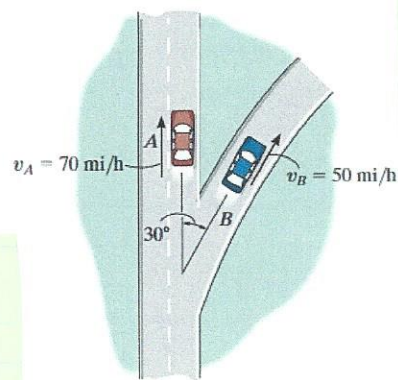
$$|\vec{V}_{A/B}| = \sqrt{19.04^2 + 45.3^2} = \underline{49.1 \text{ km/h}}$$



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

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/h^2 , 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

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

$$|\vec{V}_{B/A}| = \sqrt{25^2 + 26.7^2} = 36.6 \text{ mph}$$

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

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

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

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

$$\theta = \tan^{-1} \frac{26.7}{25} = 46.9^\circ$$

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

$$\frac{50^2}{0.7} = 3571 \text{ mph}^2$$

$$x \rightarrow 1100 \cos 60 + 3571 \cos 30 = 0 + (a_{B/A})_x$$

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

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

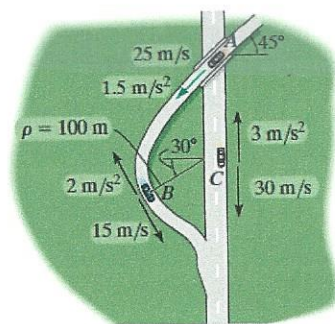
$$(a_{B/A})_y = -833 = 833 \text{ mph}^2 \downarrow$$

$$|\vec{a}_{B/A}| = \sqrt{3642^2 + 833^2} = 3740 \text{ mph}^2$$

$$\theta = \tan^{-1} \frac{833}{3642} = 12.9^\circ$$

*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

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

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

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

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

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

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

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

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

21.5

12.32

17.68

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

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

1.5 m/s^2 $\swarrow 45^\circ$ = \uparrow 3 m/s^2 + $\vec{a}_{A/C}$

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

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

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

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

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

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

1.06

4.06

4.20

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

$$= 75.4^\circ$$