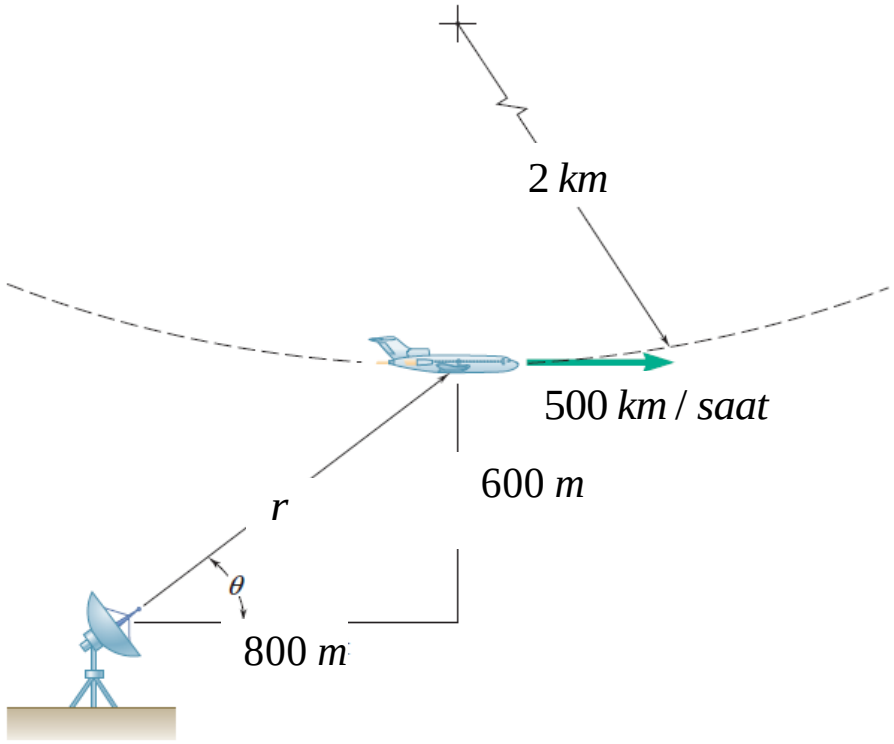
20203 Dinamik1 Quiz1 Sorusu ve cevabı

Düşey düzlemde çembersel bir yörüngede uçan uçak, en alt noktadan geçerken $500\ km/saat$ hıza ve $5\ m/s^2$ ivmeye sahiptir. Çemberin yarıçapı $2\ km$ dir.

Uçak aşağıda O daki radarla izlenmektedir. Bu anda radarın kaydettiği $r, \dot{r}, \ddot{r}, \theta, \dot{\theta}\ ve\ \ddot{\theta}$ değerlerini bulunuz.

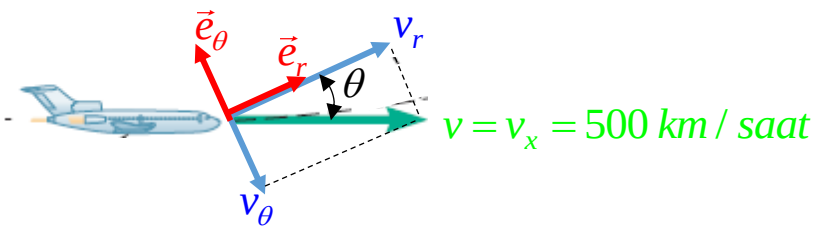


Çözüm:

$$R = 2000\ m$$

$$r = \sqrt{800^2 + 600^2}\ , \quad \boxed{r = 1000\ m}, \quad \theta = \arctan\frac{600}{800}\ , \quad \boxed{\theta = 36.87^0}$$

Silindirik ve Kartezyen koordinatlarda hız analizi:



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$$v_r = v\cos\theta = 500\cos 36.87^0 = 500\times\frac{4}{5} = 400\ km/saat$$

$$v_\theta = -v\sin\theta = -500\sin 36.87^0 = -500\times\frac{3}{5} = -300\ km/saat$$

$$v_r = 400\ km/saat = \frac{400\times 1000}{60\times 60} = \frac{1000}{9}\ m/s = 111.111\ m/$$

$$v_\theta = 300\ km/saat = -\frac{300\times 1000}{60\times 60}\ m/s = -\frac{250}{3}\ m/s = -83.333\ m/s$$

$$v_r = \dot{r} = \frac{1000}{9}\ m/s = 111.111\ m/s\ , \quad \boxed{\dot{r} = 111.111\ m/s}$$

$$v_\theta = r\dot{\theta} = -\frac{250}{3}\ m/s = -83.333\ m/s \ \Rightarrow$$

$$\dot{\theta} = \frac{v_\theta}{r} = \frac{-250}{3\times 1000}\ rad/s = -\frac{1}{12}\ rad/s = -0.0833\ rad/s,$$

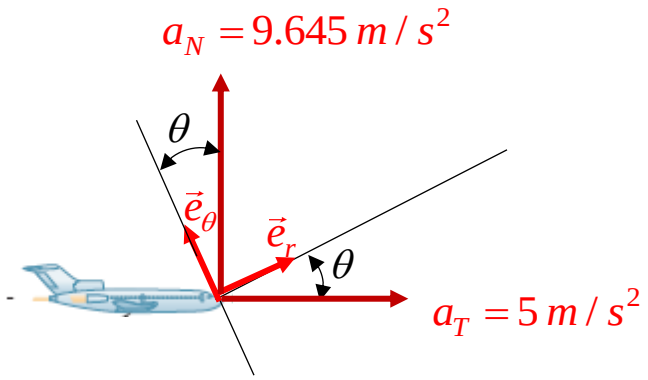
$$\boxed{\dot{\theta} = -0.0833\ rad/s}$$

Silindirik ve doğal koordinatlarda ivme analizi:

$$a_T = 5\ m/s^2$$

$$a_N = \frac{v^2}{R} = \frac{(500/3.6)^2}{2000} = \frac{(138.8889)^2}{2000}\ m/s^2\ ,$$

$$a_N = 9.645\ m/s^2$$



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$$a_r = a_T \cos\theta + a_N \sin\theta$$

$$a_\theta = -a_T \sin\theta + a_N \cos\theta$$

$$a_r = 5 \times \frac{4}{5} + 9.645 \times \frac{3}{5} = 9.787\ m/s^2$$

$$a_\theta = -5 \times \frac{3}{5} + 9.645 \times \frac{4}{5} = 4.716\ m/s^2$$

$$a_r = \ddot{r} - r\dot{\theta}^2 \ \Rightarrow \quad \ddot{r} = a_r + r\dot{\theta}^2$$

$$\ddot{r} = 9.787 + 1000\left(-0.0833\right)^2 , \qquad \boxed{\ddot{r} = 16.73\ m/s^2}$$

$$a_\theta = r\ddot{\theta} + 2\dot{r}\dot{\theta} \ \Rightarrow$$

$$\ddot{\theta} = \frac{1}{r}\left(a_\theta - 2\dot{r}\dot{\theta}\right) = \frac{1}{1000}\left[4.716 - 2 \times 111.111\left(-0.0833\right)\right]$$

$$\boxed{\ddot{\theta} = 0.0232\ rad/s^2}$$

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