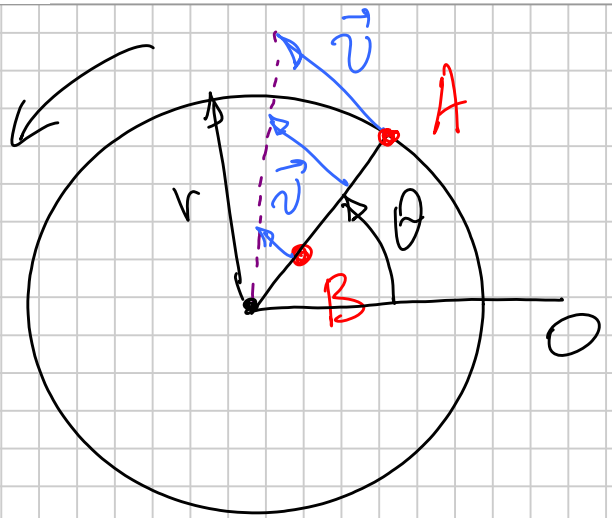
Lecture 9. Angular variables. Problems.

Note Title 9/21/2011



2π rad $= 360°$

$2\pi \frac{\text{rad}}{s} = \frac{1 \text{ rev.}}{s}$

$$\begin{cases} \theta & - \text{rad} \\ \omega & - \frac{\text{rad}}{s} \end{cases}$$

$$v = \frac{2\pi r}{T}$$

$$f = \frac{1}{T} \quad \frac{\text{rev.}}{s} = s^{-1} \quad [Hz]$$

x $\quad v = \frac{dx}{dt}$

θ $\quad \boxed{\omega = \frac{d\theta}{dt}}$ angular velocity

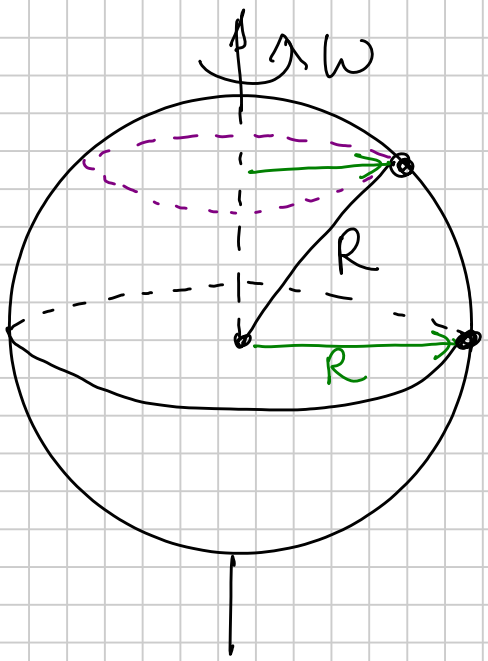
$$\boxed{\omega = 2\pi \cdot f}$$

$$\boxed{\omega = \frac{2\pi}{T}}$$

$$\boxed{v = \omega \cdot r}$$

$$a_c = \frac{v^2}{r} = \frac{\omega^2 r^2}{r} = \omega^2 r$$

$$\boxed{a_c = \omega^2 r}$$



$$\omega = \frac{2\pi}{T}$$

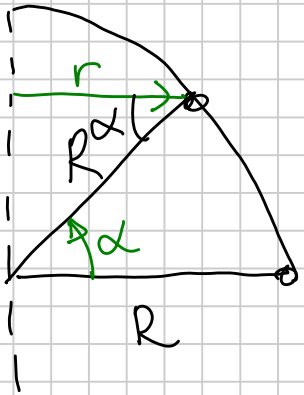
$$R = 6400\ km$$

$$a_c = \omega^2 R = \left(\frac{2\pi}{T}\right)^2 R =$$

$$= \left(\frac{2\pi}{24 \cdot 60 \cdot 60}\right)^2 \cdot \underbrace{6400 \cdot 10^3}_{m} = 3.4 \cdot 10^{-2} \frac{m}{s^2} =$$

$$= 0.034 \frac{m}{s^2}$$

$$g = 9.8\ m/s^2$$

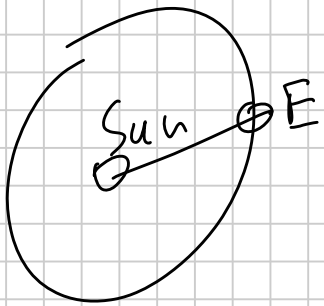


$$\alpha = 46°$$

$$r = R\cos 46°$$

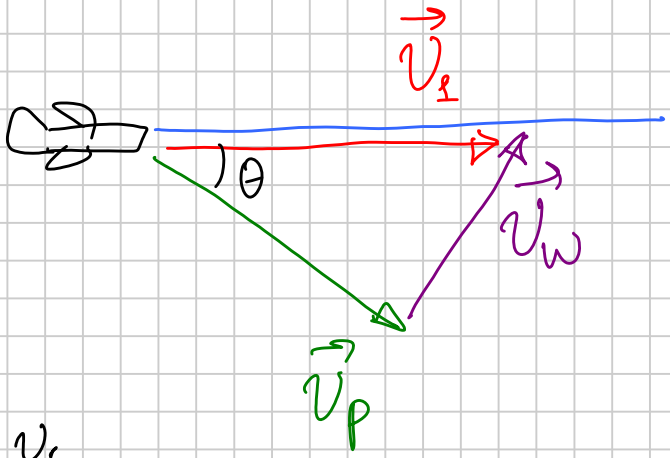
$$a_c = \omega^2 r = \omega^2 R \underbrace{\cos 46°}_{\simeq \frac{1}{\sqrt{2}}} = \frac{0.034}{\sqrt{2}} \simeq 0.024\ m/s^2$$

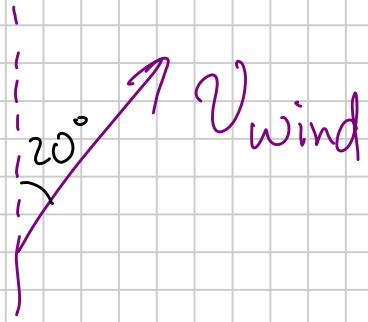
$$v = \omega r$$



$$a_c \simeq 10^{-5}\ m/s^2$$

EX



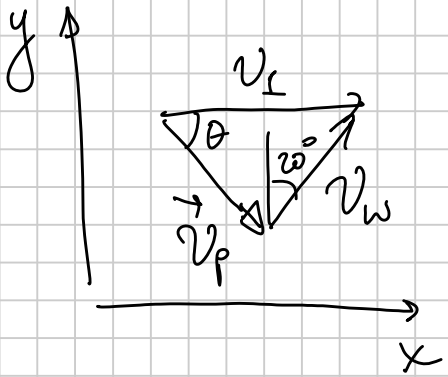


$v_{wind} = 65$ km/h

$v_{plane} = 215$ km/h

v_1 - ?

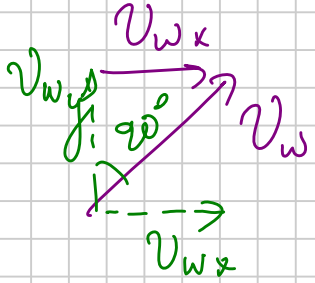
θ - ?

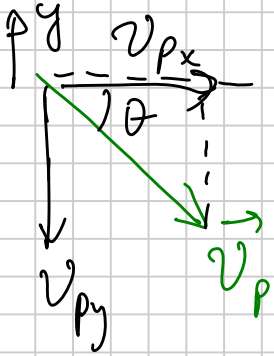


$$\vec{v}_p + \vec{v}_w = \vec{v}_1$$

$$x: \; v_{px} + v_{wx} = v_{1x}$$

$$y: \; v_{py} + v_{wy} = v_{1y}$$





$$v_w \begin{cases} v_{wx} = v_w \sin 20^\circ \\ v_{wy} = v_w \cos 20^\circ \end{cases}$$

$$v_p \begin{cases} v_{px} = v_p \cos\theta \\ v_{py} = v_p \sin\theta \end{cases}$$

projections

$$y: \; -v_p \sin\theta + v_w \cos 20^\circ = 0$$

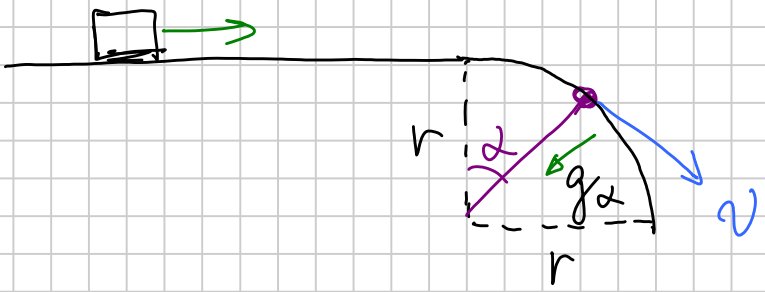
$$\sin\theta = \frac{v_w \cos 20^\circ}{v_p} = \frac{65 \cos 20^\circ}{215} = 0.28$$

$$\theta = 16.5^\circ$$

$$x: \; v_p \cos\theta + v_w \sin 20^\circ = v_{1x} = v_1$$

$$v_1 = 215 \cos 16.5^\circ + 65 \cdot \sin 20^\circ = 228 \text{ km/h}$$

EX:



$\alpha - ?$

$$a_c = \frac{v^2}{r} > g_\alpha$$