# ESERCIZI SUL MOTO CIRCOLARE 2

prof. A. PISANI

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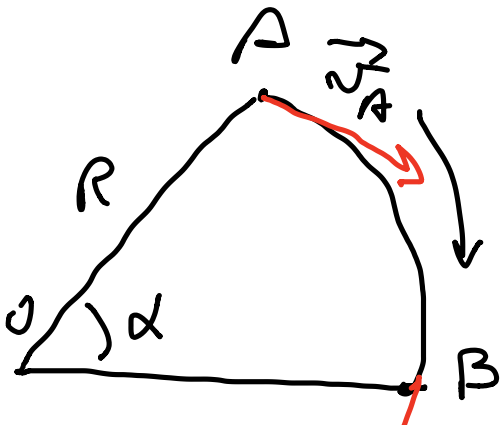
## ES 48 p. 192

**48** ★★★ Una rondine vola nel cielo alla velocità costante in modulo di 4,5 m/s percorrendo un arco di circonferenza di 60° in verso orario in 6,3 s.

- Disegna i vettori velocità nel punto iniziale e in quello finale.
- Disegna il vettore variazione di velocità.
- Calcola l'accelerazione centripeta.

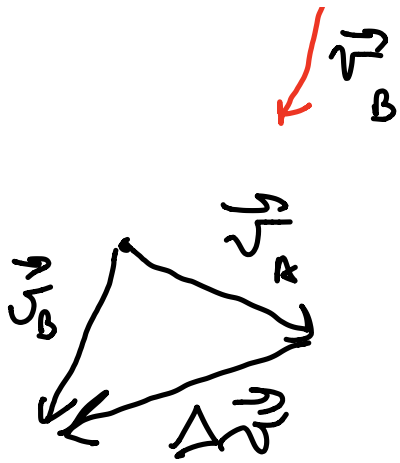
[0,75 m/s²]




$\widehat{BOA} = 60° = \alpha$

$v = 4.5\ m/s$

$|\vec{v}_A| = |\vec{v}_B| = v$




$$\Delta\vec{v} = \vec{v}_B - \vec{v}_A$$

$$a = v^2/R$$

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

$$\Delta\alpha = 60^\circ = \frac{\pi}{3}\ (\text{rad})$$

$$\Delta t = 6.3\ s$$

$$\omega = \frac{\Delta\alpha}{\Delta t} = \frac{\pi/3}{6.3s} = \frac{2\pi}{T}$$

$$T = \Delta t \cdot \frac{2\pi}{\pi/3} = 6 \cdot \Delta t$$

$$T = 6 \times 6{,}3\ s = 37{,}8\ s$$

$$v = \frac{2\pi R}{T} \Rightarrow R = \frac{v \cdot T}{2\pi}$$

$$R = \frac{4.5\ m/s \cdot 37.8\ s}{2\pi}$$

$$= 27.1\ m.$$

$$a = \frac{v^2}{R} = \frac{(4.5\ m/s)^2}{27.1\ m}$$

$$\simeq 0.75\ m/s^2.$$

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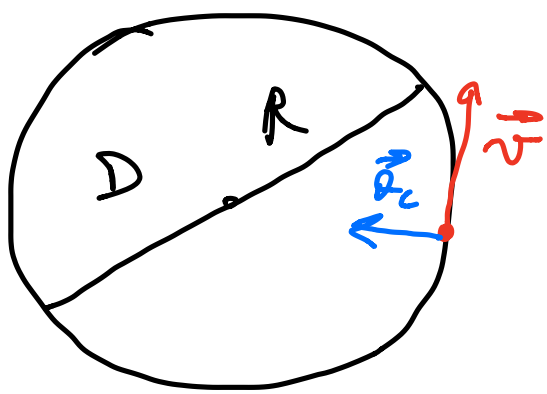
**45** ★★★ I vecchi dischi in vinile detti "a 33 giri" (anche detti "Long Playing") avevano questo nome perché compiono circa 33 giri al minuto. Il loro diametro è 30 cm.

- Calcola l'accelerazione centripeta di un punto sul bordo del disco.

[1,8 m/s$^2$]




$D = 2R$

$\doteq 30$ cm

$R = 15$ cm

$\doteq 0.15$ m

33 giri / min

$$f = \frac{33}{60\,s} = 0.55\ Hz$$

$$T = 1/f = 1.82\ s$$

$$a_c = v^2/R = \omega^2 \cdot R$$

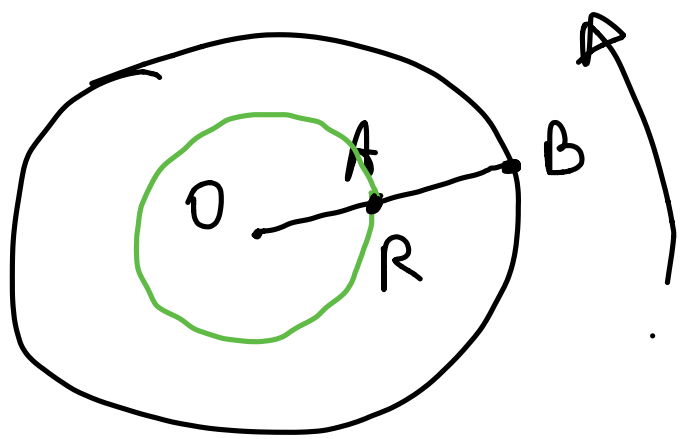
$$\omega = 2\pi \cdot f = 2\pi \cdot 0.55\ Hz$$

$\doteq 3.46$ rad/s

$$a_c = \omega^2 R =$$

$$= (3.46\ rad/s)^2 \cdot 0{,}15\,m$$

$$= 1.73\ m/s^2 .$$




$$\omega = 2\pi f = 2\pi / T$$

$$\left.\begin{aligned} T(A) &= T(B) \\ f(A) &= f(B) \end{aligned}\right\} \Rightarrow \omega_A = \omega_B$$

$$v_A \neq v_B \qquad v = \omega \cdot R$$

$$R_A \neq R_B$$

$$v_A = \omega \cdot R_A$$

$$v_B = \omega \cdot R_B$$

$$R_B = 2R_A \qquad R_A = \frac{1}{2} R_B$$

$$\Downarrow$$

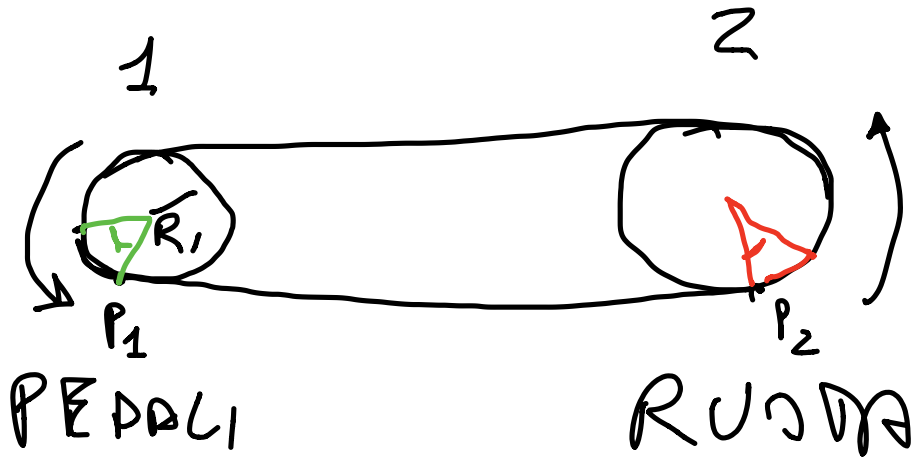
$$v_B = \omega R_B = \omega \cdot 2R_A =$$

$$= 2\omega R_A = 2v_A$$

$$a = \omega^2 R \qquad a \propto R$$

$$a_A = \frac{1}{2} a_B$$

$$a_B = 2a_A \leftarrow R_B = 2R_A.$$




$$P_1 : \Delta l \rightarrow P_2 : \Delta l$$

$$\Delta\alpha_1 = \frac{\Delta l}{R_1} \qquad \Delta\alpha_2 = \frac{\Delta l}{R_2}$$

$$R_2 > R_1 \Rightarrow \Delta\alpha_2 < \Delta\alpha_1$$

$$\Delta t \quad 1 : \Delta\alpha_1 \qquad \Delta\alpha_2$$

$$\omega_1 = \frac{\Delta\alpha_1}{\Delta t} \qquad \omega_2 = \frac{\Delta\alpha_2}{\Delta t}$$

$$\omega_1 = \frac{2\pi}{T_1} \qquad \omega_2 = \frac{2\pi}{T_2}$$

$$\Delta l = \Delta\alpha \cdot R$$

$$\overset{!}{=} \Delta\alpha_1 \cdot R_1 = \Delta\alpha_2 \cdot R_2$$

$$\overset{\omega_1}{\frac{\Delta\alpha_1 R_1}{\Delta t}} = \overset{\omega_2}{\frac{\Delta\alpha_2 R_2}{\Delta t}}$$

$$\omega_1 R_1 = \omega_2 R_2$$

$$\boxed{\omega_1 \propto 1/R_1}$$

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

$$\boxed{T \propto R}$$

$$R_1 = 0.1 \text{ m}$$

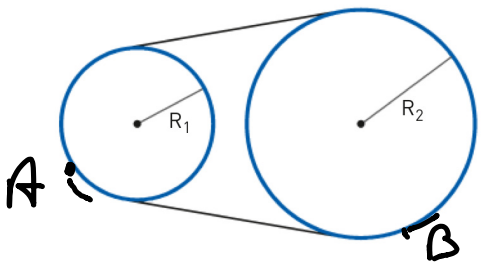
$$R_2 = 0.2 \text{ m}$$

$$\boxed{R_2 = 2 R_1}$$

$$\boxed{T_2 = 2 T_1}$$

$$\boxed{\omega_2 = \frac{1}{2} \omega_1}$$

**9** ★★★ Due ruote di raggi $R_1$ = 20 cm e $R_2$ = 30 cm, libere di ruotare attorno ai loro centri, sono collegate tramite una cinghia di trasmissione aderente ai bordi delle ruote. In questo modo se si fa girare la prima ruota, lo spostamento della cinghia costringe anche la seconda a girare, senza che la cinghia slitti sulle ruote.




- Spiega per quale motivo i bordi delle ruote hanno la stessa velocità.
- La ruota più piccola compie 3 giri in 1,0 s. Calcola il periodo di rotazione della ruota più grande.

[0,50 s]

$$v_A = v_B = \frac{\Delta l}{\Delta t}$$

$$v_A = \omega_1 R_1 \qquad v_B = \omega_2 R_2$$

$$f_1 = \frac{3}{1\,s} = 3\ Hz$$

$$T_1 = 1/f_1 = 0.\overline{3}\ s$$

$$v_A = \frac{2\pi R_1}{T_1} \qquad v_B = \frac{2\pi R_2}{T_2}$$

$$v_A = v_B$$

$$\frac{2\pi R_1}{T_1} = \frac{2\pi R_2}{T_2}$$

$$\frac{R_1}{T_1} = \frac{R_2}{T_2}$$

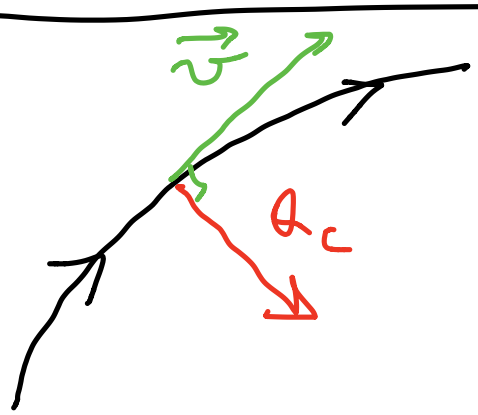
$$\frac{T_1}{R_1} = \frac{T_2}{R_2} \qquad \cdot R_2$$

$$R_2 \frac{T_1}{R_1} = T_2$$

$$T_2 = T_1 \cdot \frac{R_2}{R_1}$$

$$= \underbrace{0{,}33\,s}_{1/3} \cdot \frac{30\,cm}{20\,cm}$$

$$= \frac{1}{2}\,s = 0.5\,s$$

$$f_2 = \frac{1}{T_2} = 2\,Hz.$$

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