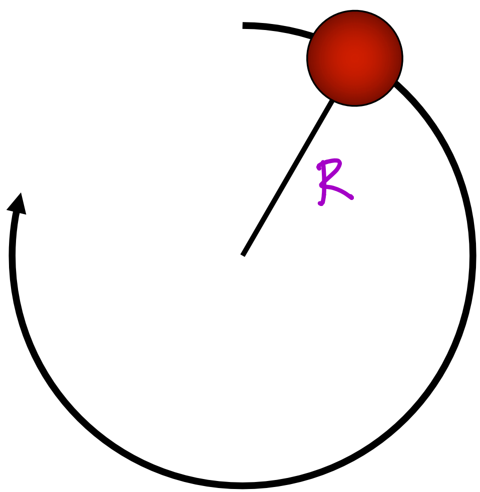
LE MOUVEMENT CURVILIGNE

PGC-03

MOUVEMENT CIRCULAIRE UNIFORME

Quelle accélération subit un corps en mouvement circulaire uniforme ?

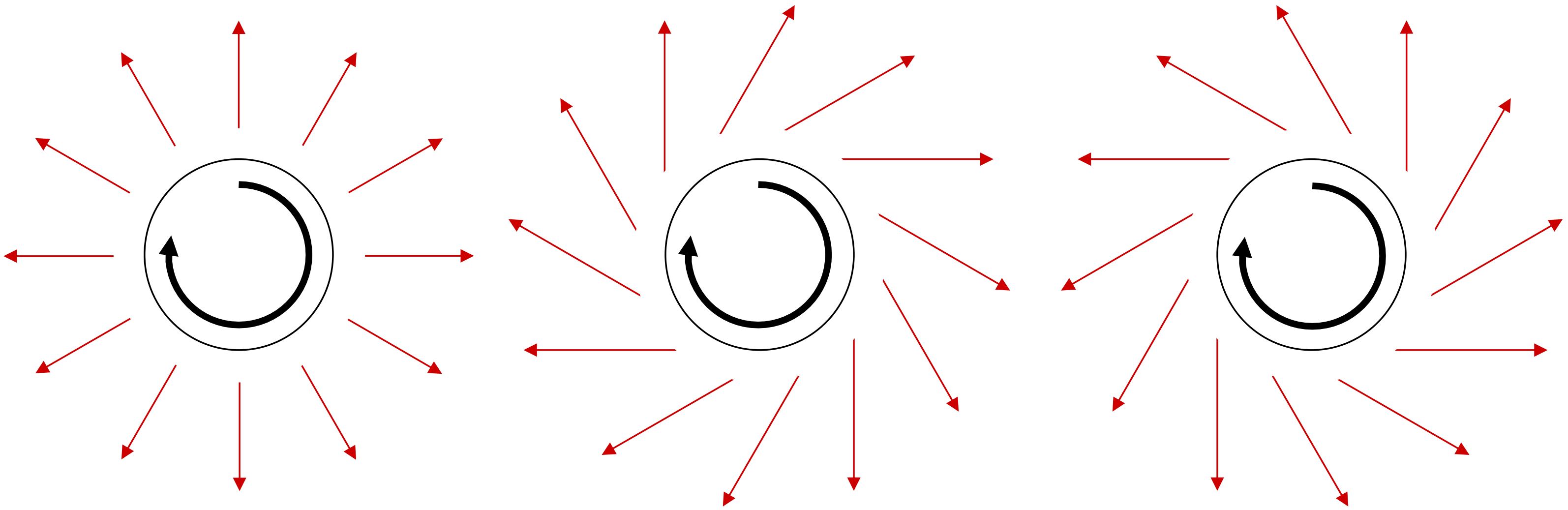


$$v = \frac{1 \text{ circumference}}{1 \text{ periode}}$$

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

MOUVEMENT CIRCULAIRE UNIFORME

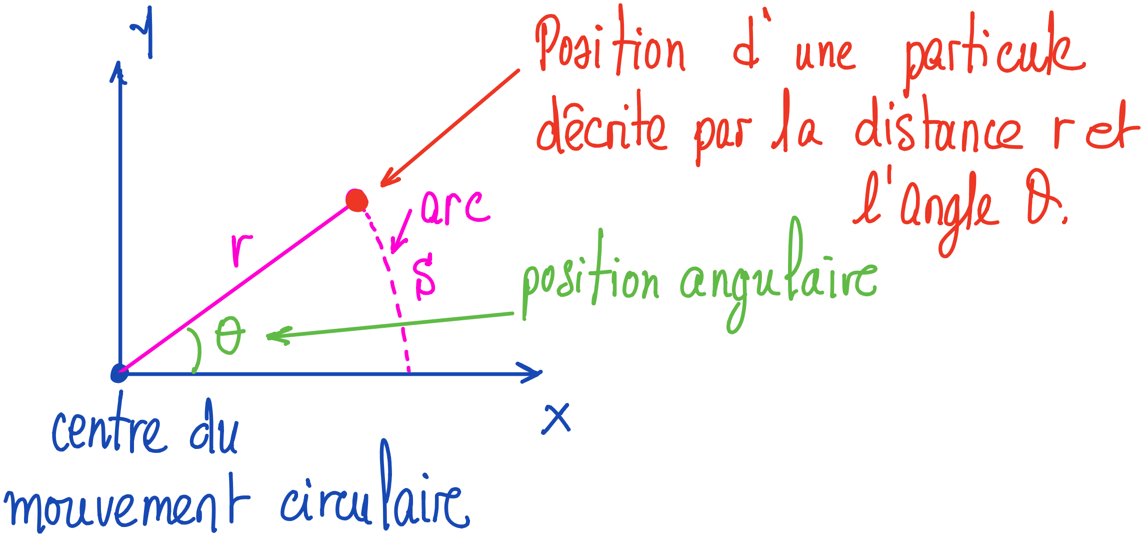
Quelle accélération subit un corps en mouvement circulaire uniforme ?



MOUVEMENT CIRCULAIRE UNIFORME

$\theta \equiv \frac{s}{r}$ (radiant)

cercle entrier $\theta = \frac{2\pi r}{r} = 2\pi$ (rad)

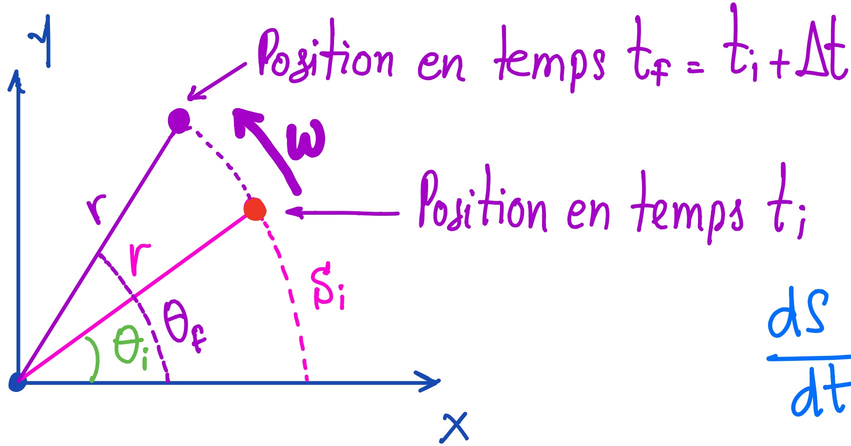


MOUVEMENT CIRCULAIRE UNIFORME

$$\theta = \frac{S}{r} \Rightarrow S = \theta \cdot r$$

$$\Delta S = r \cdot \Delta\theta$$

$$\frac{\Delta S}{\Delta t} = r \frac{\Delta\theta}{\Delta t} \qquad \Delta t \to 0$$



$$\frac{dS}{dt} = r \frac{d\theta}{dt}$$

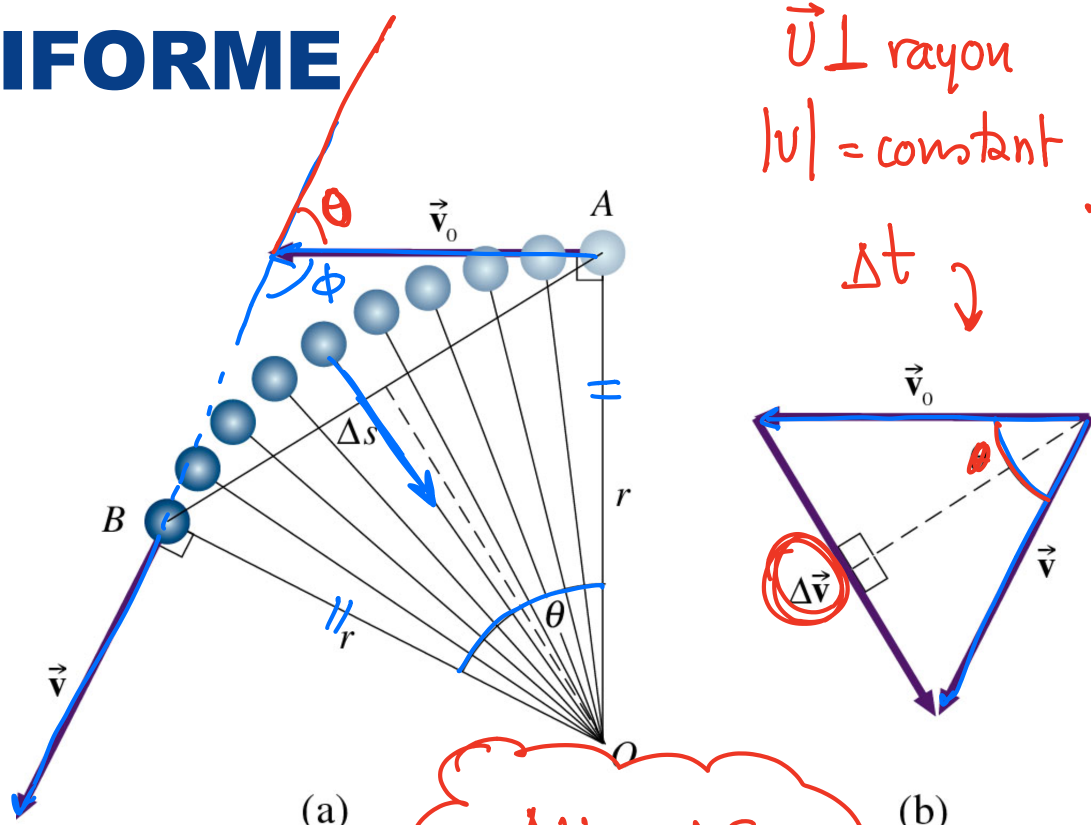
$$v = r \cdot \omega \qquad [\omega] = \frac{rad}{s}$$

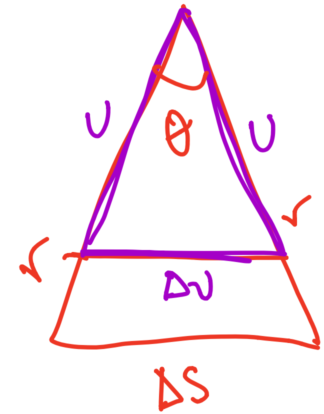
MOUVEMENT CIRCULAIRE UNIFORME

$\vec{v} \perp$ rayon

$|v| = \text{constant}$

Δt





$$\frac{\Delta v}{v} = \frac{\Delta S}{r}$$

ACCÉLÉRATION CENTRIPÈTE

$$\frac{\Delta v}{v} = \frac{\Delta s}{r} \Rightarrow \Delta v = \frac{v}{r}\,\Delta s \Rightarrow \left.\begin{array}{l} \dfrac{\Delta v}{\Delta t} = \dfrac{v}{r}\,\dfrac{\Delta s}{\Delta t} \\ \Delta t \to 0 \end{array}\right\} \Rightarrow a = \frac{v}{r} \cdot v$$

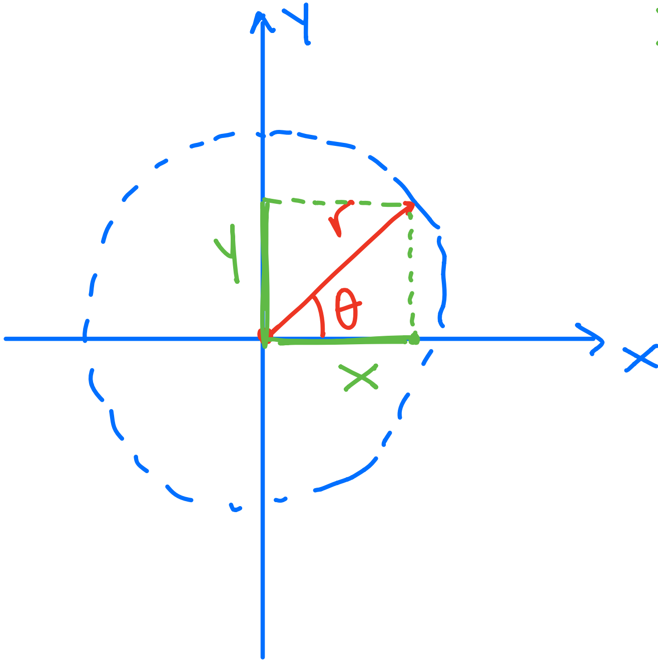
$$a_c = \frac{v^2}{r}$$

acceleration centripete

$$v = r \cdot \omega$$

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

...DÉRIVATION EN COORDONNÉES CARTÉSIENNES



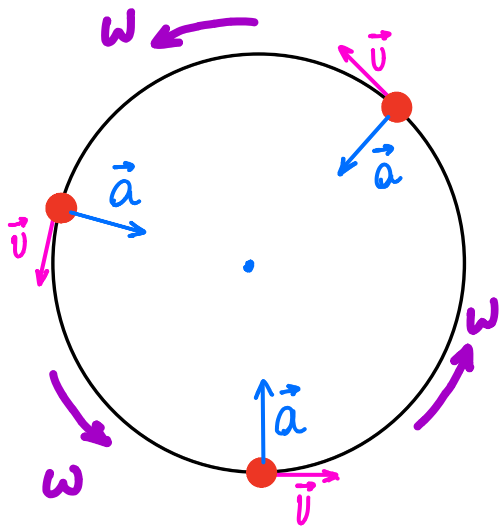
$$x = r\cos\theta$$

$$y = r\sin\theta$$

$$\frac{d\theta}{dt} = \omega = \text{const.}$$

$v,\ a,\ \omega$

ACCÉLÉRATION CENTRIPÈTE



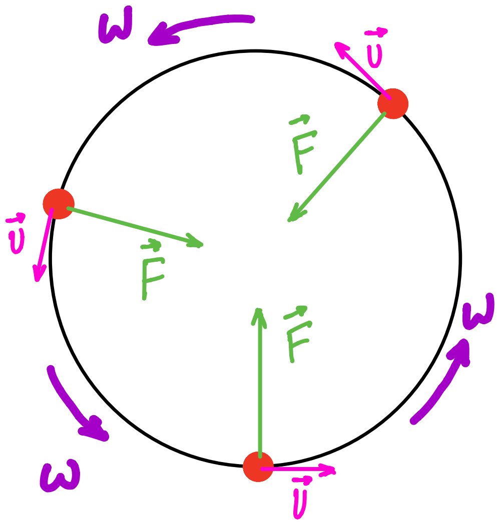
$$\vec{a} = \frac{\Delta \vec{v}}{\Delta t}$$

$$\vec{F} = m\vec{a}$$

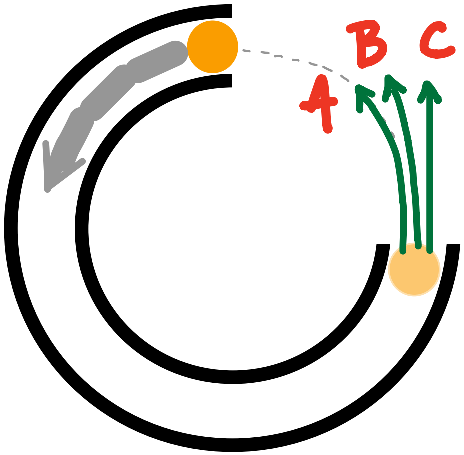
$$\vec{F} = m\frac{\Delta \vec{v}}{\Delta t}$$

$$\boxed{F_c = \frac{m v^2}{r}}$$

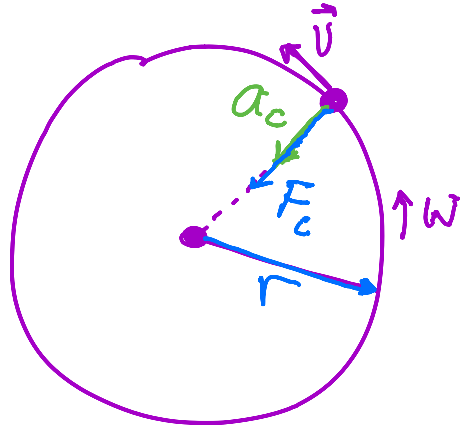
FORCE CENTRIPÈTE



A, B OU C?



RECAP



$$\omega = \frac{d\theta}{dt}$$

v, ω : const

$$v = r\omega$$

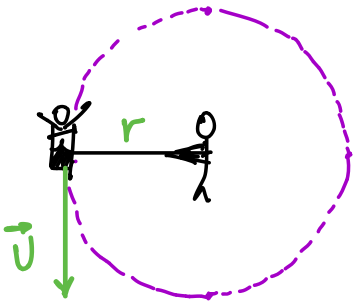
$$a_c = \frac{v^2}{r} = \omega^2 r$$

$$\vec{F}_c = m\vec{a}_c \Rightarrow F_c = \frac{mv^2}{r} = m\omega^2 r$$

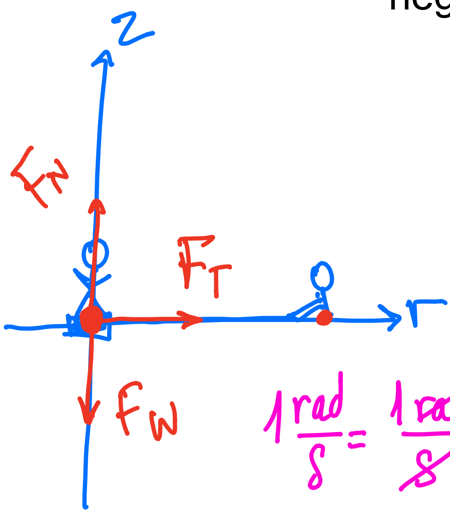
$\vec{a} \parallel \vec{r}$

$\vec{a}_c, \vec{F}_c \downarrow$ centre circle

EXEMPLE – KART TOURNANT



Un papa tourne son enfant de 20 kg qui est dans un kart de 5 kg attaché d'une corde de longueur de 2 m, comme montré dans la figure, en tenant la corde parallèle au sol. La tension de la corde est de 100 N. Combiens de révolutions par minute (rpm) le kart fait-il? Nous considérons le frottement par roulement négligeable.



$m_e = 20\ Kgr$

$m_K = 5\ Kg$

$F_T = 100\ N$

$r = 2\ m$

$\omega = ?$

$\sum F_z = 0 \Rightarrow F_N = F_W$

$\sum F_r = F_T = m a_c \Rightarrow$

$\Rightarrow F_T = m \omega^2 r \Rightarrow$

$\Rightarrow \omega = \sqrt{\frac{F_T}{m r}} =$

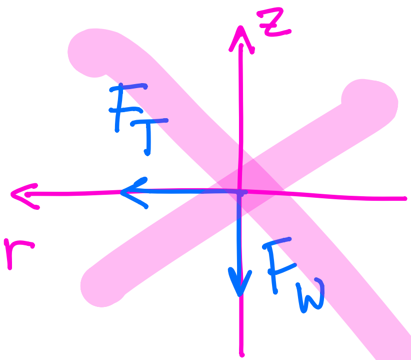
$= \dots 1.41\ rad/s$

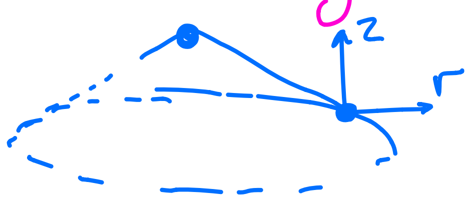
$$1 \frac{rad}{s} = \frac{1\ \cancel{rad}}{\cancel{s}} \cdot \frac{1\ rev}{2\pi\ \cancel{rad}} \cdot \frac{60\ \cancel{s}}{1\ min} = \dots$$

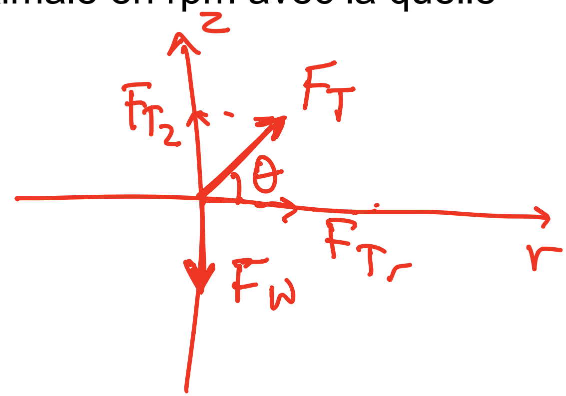
EXEMPLE – PIERRE SUR CORDE

Un chasseur de l'âge de pierre fixe une pierre sur une corde de longueur d'1 m et la tourne dessus de sa tête 'horizontalement'. Si la corde se casse à une tension de 200 N, quelle est la vitesse angulaire maximale en rpm avec la quelle il peut faire tourner la pierre?

$m = 10\ kg$







$$\sum F_r = F_T = m a_c$$

$$\cancel{\sum F_z = F_W = m a_z}$$

$$\sum F_y = 0 \Rightarrow F_{T_z} = F_W \Rightarrow \theta = \cdots$$

$$\sum F_x = F_{T_r} = m a_c = \frac{m v^2}{r}$$