FIZIKA

PREDAVANJA

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UVOD

- Fizika je nauka koja proučava gradju i svojstva materije, njene interakcije i transformacije, pojave u prirodi koje su dostupne merenju i otkriva zakone po kojima se te pojave dešavaju.

- Fizika predstavlja osnovu svih prirodnih i tehničkih nauka.

Merenje neke veličine

- Izmeriti neku veličinu znači uporediti je sa jednom usvojenom jedinicom koja je definisana standardom.
- Veličine mogu biti osnovne i izvedene.
- Osnovne veličine i jedinice definisane su SI sistemom.

SI sistem

Osnovne veličine	Ime jedinice	Simbol
dužina	metar	m
masa	kilogram	kg
vreme	sekunda	s
električna struja	amper	A
termodinamička temperatura	kelvin	K
količina supstance	mol	mol
količina svetlosti	kandela	cd

MEHANIKA

- Mehanika-deo fizike u kojem se izučavaju najjednostavniji oblici kretanja materije-mehanička kretanja tj. kretanje tela u prostoru i vremenu.
- Podela mehanike:

  --Kinematika

  --Dinamika

  --Statika

Kinematika

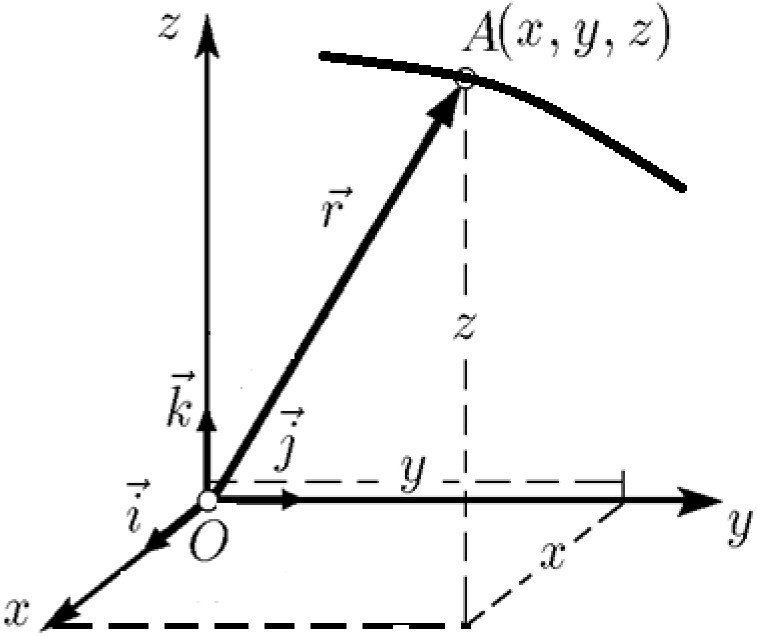
Osnovne veličine:

- dužina
- vreme

Model:

- čestica

Položaj čestice



- Položaj čestice određen je radijus vektorom $\vec{r}$ ili njenim koordinatama.

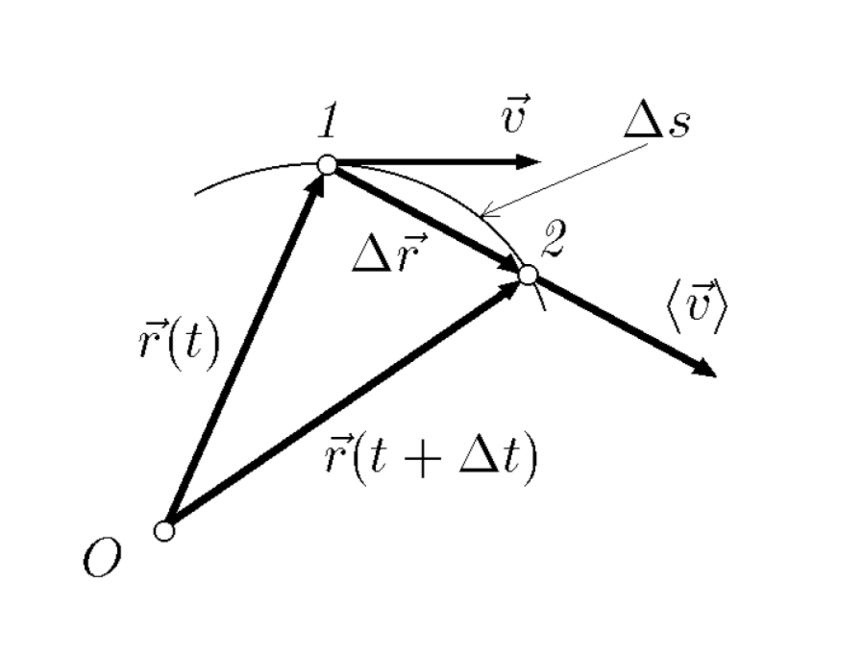
$$\vec{r} = x\vec{i} + y\vec{j} + z\vec{k}$$

$$\vec{r} = \vec{r}(t) = x(t)\,\vec{i} + y(t)\,\vec{j} + z(t)\,\vec{k}$$

$$x = x(t), \quad y = y(t), \quad z = z(t)$$

$$f(x, y, z) = 0$$

Brzina opisana pomoću vremenske zavisnosti radijus vektora



$$\Delta \vec{r} = \vec{r}(t+\Delta t) - \vec{r}(t)$$

$$\langle \vec{v} \rangle = \Delta \vec{r} / \Delta t$$

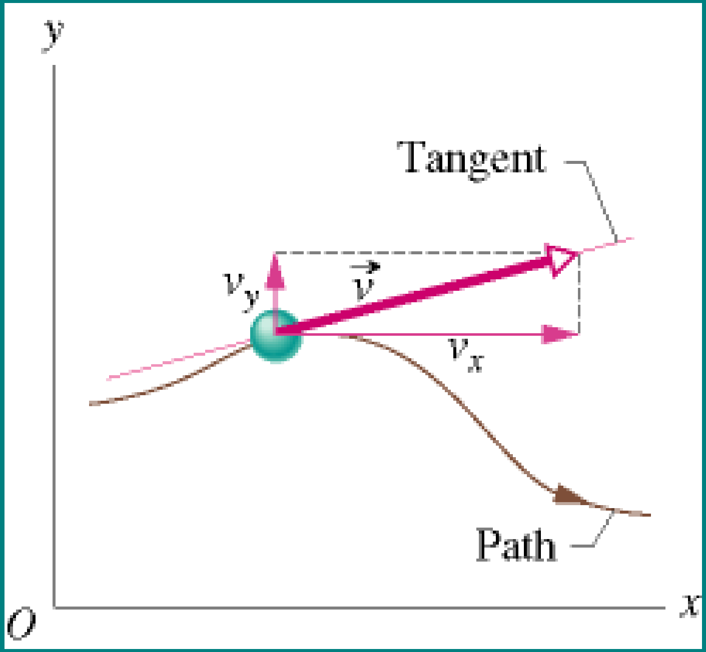
$$\vec{v} = \lim_{\Delta t \to 0} \frac{\Delta \vec{r}}{\Delta t} = \frac{\mathrm{d}\vec{r}}{\mathrm{d}t}$$

$$v = |\vec{v}| = \left| \frac{\mathrm{d}\vec{r}}{\mathrm{d}t} \right|$$

Brzina opisana pomoću vremenske zavisnosti koordinata

$$\vec{v} = v_x\vec{i} + v_y\vec{j} + v_z\vec{k}$$

$$\vec{v} = \frac{d\vec{r}}{dt} = \frac{d}{dt}\left(x\vec{i} + y\vec{j} + z\vec{k}\right) = \frac{dx}{dt}\vec{i} + \frac{dy}{dt}\vec{j} + \frac{dz}{dt}\vec{k}$$

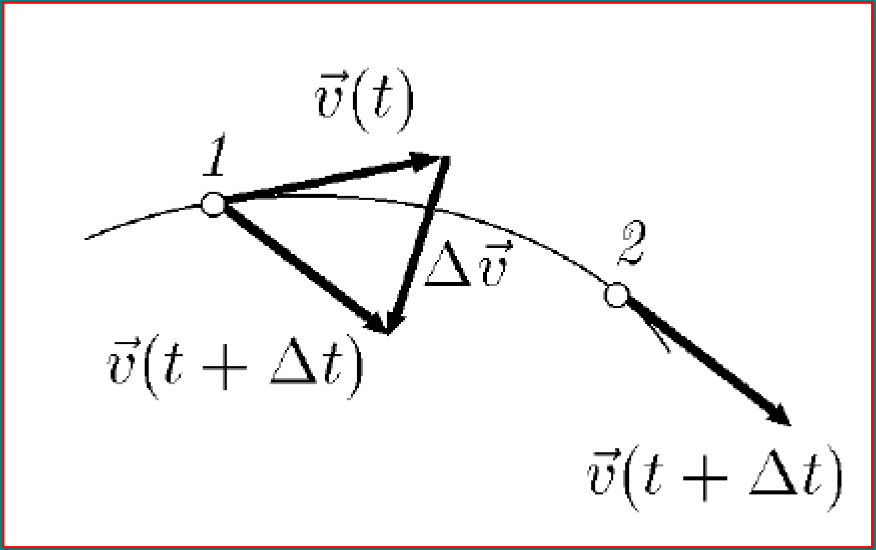


$$v_x = \frac{dx}{dt}, \quad v_y = \frac{dy}{dt} \quad \text{i} \quad v_z = \frac{dz}{dt}$$

$$v = \sqrt{v_x^2 + v_y^2 + v_z^2}$$

Jedinica
m/s

Ubrzanje opisano pomoću vremenske zavisnosti radijus vektora

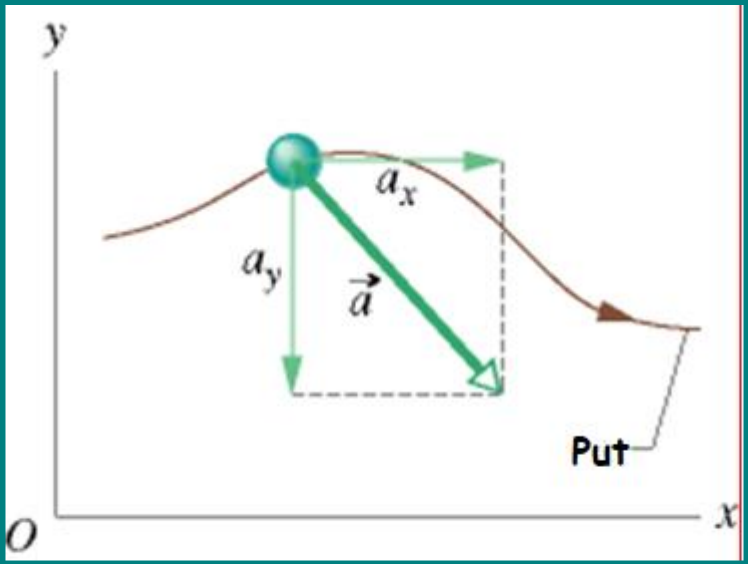


$$\Delta\vec{v} = \vec{v}(t+\Delta t) - \vec{v}(t)$$

$$\langle\vec{a}\rangle = \Delta\vec{v}/\Delta t$$

$$\vec{a} = \lim_{\Delta t\to 0}\frac{\Delta\vec{v}}{\Delta t} = \frac{\mathrm{d}\vec{v}}{\mathrm{d}t} = \frac{\mathrm{d}}{\mathrm{d}t}\left(\frac{\mathrm{d}\vec{r}}{\mathrm{d}t}\right) = \frac{\mathrm{d}^2\vec{r}}{\mathrm{d}t^2}$$

Ubrzanje opisano pomoću vremenske zavisnosti koordinata



$$\vec{a} = a_x\vec{i} + a_y\vec{j} + a_z\vec{k}$$

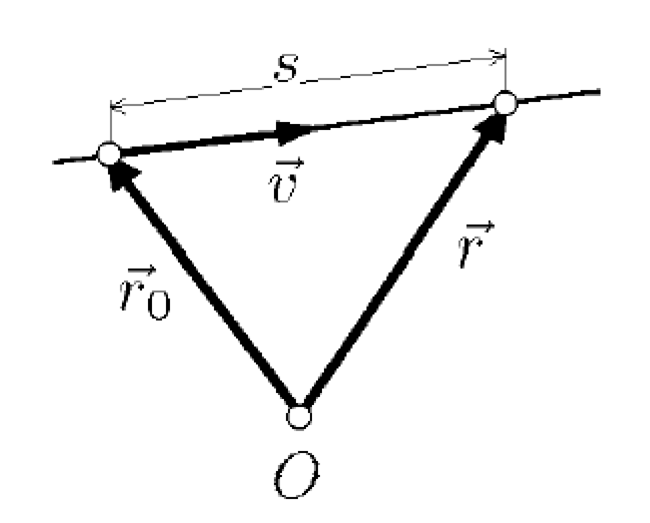
$$\vec{a} = \frac{d}{dt}(v_x\vec{i} + v_y\vec{j} + v_z\vec{k})$$

$$= \frac{dv_x}{dt}\vec{i} + \frac{dv_y}{dt}\vec{j} + \frac{dv_z}{dt}\vec{k}$$

$$a = \sqrt{a_x^2 + a_y^2 + a_z^2}$$

Jedinica m/s^2

Ravnomerno pravolinijsko kretanje



$$\vec{v} = \vec{\text{const}}$$

$$\vec{a} = \mathrm{d}\vec{v}/\mathrm{d}t = 0$$

$$\vec{v} = \mathrm{d}\vec{r}/\mathrm{d}t$$

$$\mathrm{d}\vec{r} = \vec{v}\,\mathrm{d}t$$

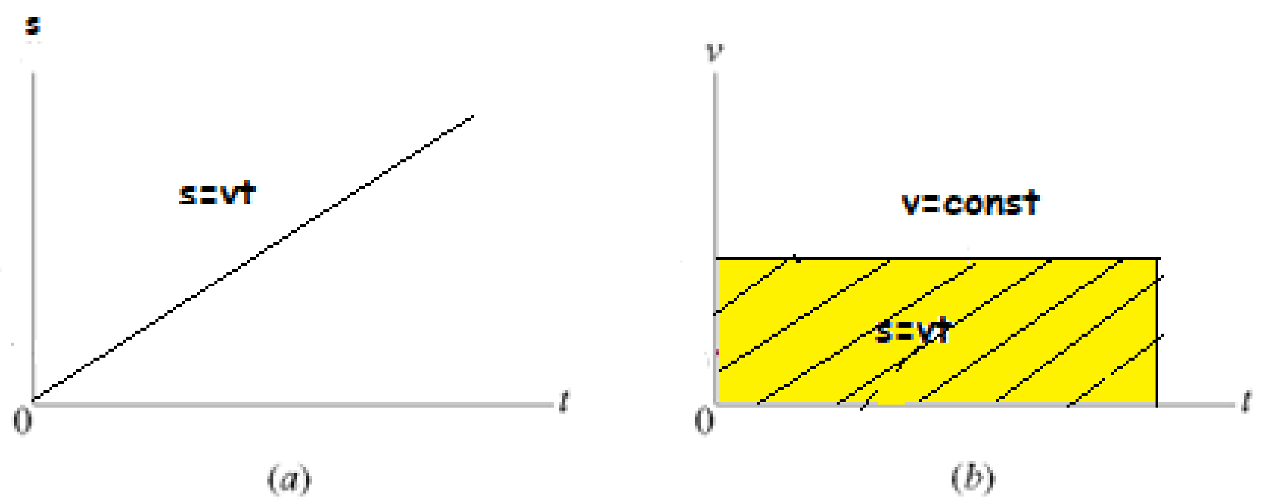
$$\int_{\vec{r}_0}^{\vec{r}} \mathrm{d}\vec{r} = \int_0^t \vec{v}\,\mathrm{d}t = \vec{v}\int_0^t \mathrm{d}t = \vec{v}\,t$$

$$\int_{\vec{r}_0}^{\vec{r}} \mathrm{d}\vec{r} = \vec{r} - \vec{r}_0$$

$$\vec{r} = \vec{r}_0 + \vec{v}t$$

$$|\vec{r} - \vec{r}_0| = s(t) = s$$

$$s = vt$$



s
s=vt
0
t
(a)
v
v=const
s=vt
0
t
(b)

Kretanje sa konstantnim ubrzanjem

Iz $\vec{a} = \mathrm{d}\vec{v}/\mathrm{d}t$ dobija se $\mathrm{d}\vec{v} = \vec{a}\,\mathrm{d}t$.

$$\int_{\vec{v}_0}^{\vec{v}} \mathrm{d}\vec{v} = \int_0^t \vec{a}\,\mathrm{d}t = \vec{a}\int_0^t \mathrm{d}t = \vec{a}\,t$$

$$\vec{v} - \vec{v}_0 = \vec{a}t, \qquad \vec{v} = \vec{v}_0 + \vec{a}t.$$

Zavisnost brzine od vremena

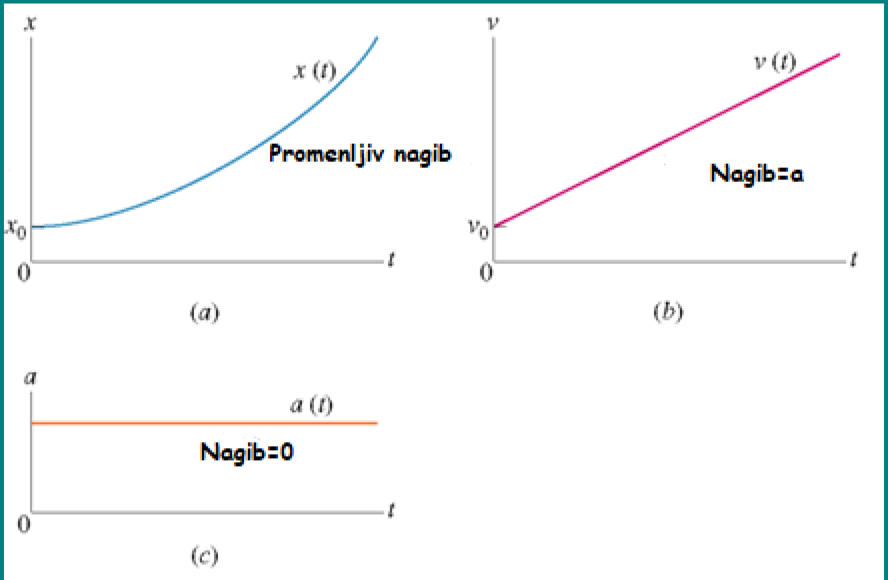
$$\mathrm{d}\vec{r} = \vec{v}\,\mathrm{d}t \qquad \int_{\vec{r}_0}^{\vec{r}} \mathrm{d}\vec{r} = \int_0^t \vec{v}\,\mathrm{d}t,$$

Zavisnost radijus vektora od vremen

$$\vec{r} - \vec{r}_0 = \int_0^t (\vec{v}_0 + \vec{a}t)\,\mathrm{d}t = \vec{v}_0 t + \frac{\vec{a}t^2}{2},$$

$$\vec{r} = \vec{r}_0 + \vec{v}_0 t + \frac{\vec{a}t^2}{2}.$$

Pravolinijsko kretanje sa konstantnim ubrzanjem



(a) $x = x_0 + v_0 t + \frac{at^2}{2}$

(b) $v = v_0 + at.$

(c) a=const.

$$v^2 = v_0^2 \pm 2as$$

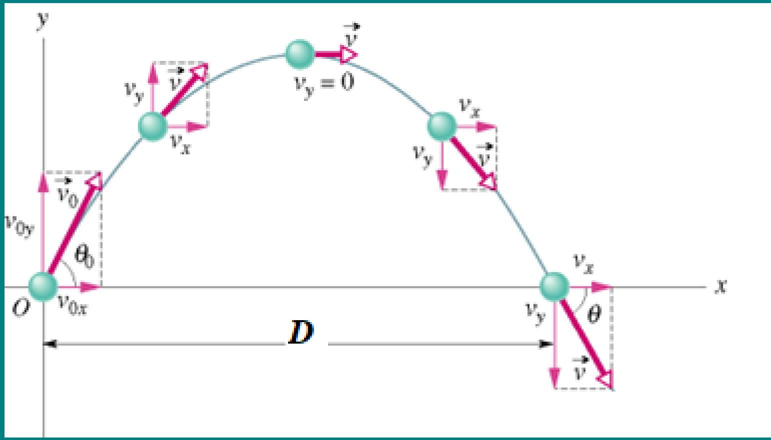
$$v = v_0 + at \Rightarrow t = \frac{v - v_0}{a}$$

$$s = v_0 t + \frac{1}{2}at^2 = v_0 \frac{v - v_0}{a} + \frac{1}{2}a\left(\frac{v - v_0}{a}\right)^2 =$$

$$= \frac{vv_0 - v_0{}^2}{a} + \frac{v^2 - 2vv_0 + v_0{}^2}{2a} = \frac{v^2 - v_0{}^2}{2a} \Rightarrow$$

$$\Rightarrow v^2 = v_0{}^2 + 2as$$

Kosi hitac



$$\vec{v}_0 = v_{0x}\vec{i} + v_{0y}\vec{j}$$

$$v_{0x} = v_0 \cos\theta_0 \quad \text{and} \quad v_{0y} = v_0 \sin\theta_0 .$$

$$v_x = v_{0x}, \quad v_y = v_{0y} - gt$$

$$x = v_{0x}t, \quad y = v_{0y}t - \frac{gt^2}{2}$$

$$x = v_{0x} \cdot t \Rightarrow t = \frac{x}{v_{0x}} = \frac{x}{v_0 \cos \Theta_0}$$

$$y = v_{0y} \cdot t - \frac{g \cdot t^2}{2} = v_0 \sin \Theta_0 \cdot t - \frac{g \cdot t^2}{2}$$

$$y = v_0 \sin \Theta_0 \cdot \frac{x}{v_0 \cos \Theta_0} - \frac{g}{2} \cdot \left(\frac{x}{v_0 \cos \Theta_0} \right)^2$$

$$y = x \cdot tg\Theta_0 - \frac{g \cdot x^2}{2 \cdot v_0^2 \cdot \cos^2 \Theta_0} \cdot$$

DOMET

Iz uslova da je y=0, dobijamo izraz za domet x=D

$$0 = D \cdot \frac{\sin \Theta_0}{\cos \Theta_0} - \frac{g \cdot D^2}{2 \cdot v_0^2 \cdot \cos^2 \Theta_0}$$

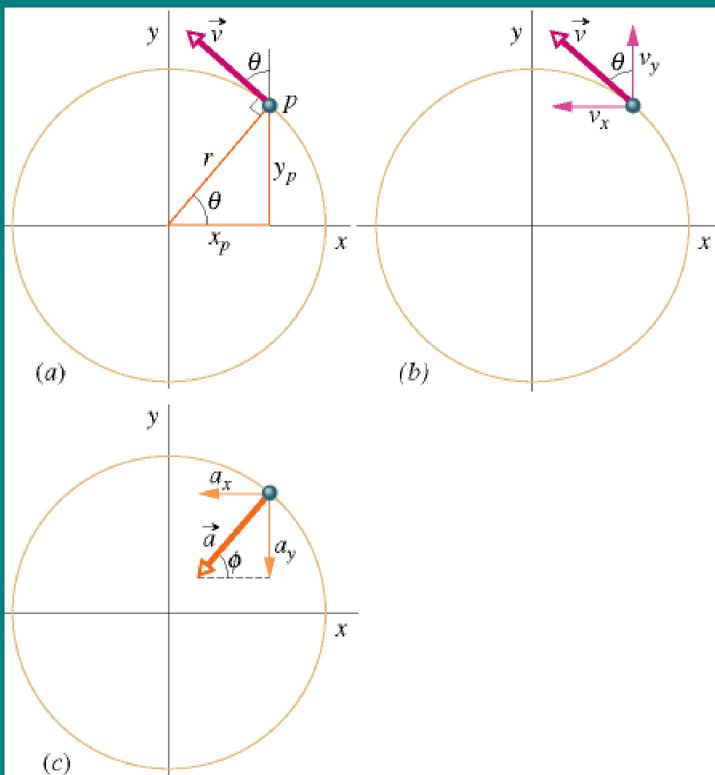
$$\sin \Theta_0 = \frac{g \cdot D}{2 \cdot v_0^2 \cdot \cos \Theta_0}$$

$$D = \frac{2v_0^2}{g} \sin \theta_0 \cos \theta_0$$

$$D = \frac{v_0^2}{g} \sin 2\theta_0$$

Domet D je maksimalan za ugao izbačaja od 45°.

Ravnomerno kružno kretanje



$$\vec{v} = v_x\vec{i} + v_y\vec{j} = (-v\sin\theta)\vec{i} + (+v\cos\theta)\vec{j}$$

$$\cos\Theta = \frac{x_p}{r}, \quad \sin\Theta = \frac{y_p}{r}$$

$$\vec{v} = \left(-\frac{v y_p}{r}\right)\vec{i} + \left(\frac{v x_p}{r}\right)\vec{j}$$

$$\vec{a} = \frac{d\vec{v}}{dt} = \left(-\frac{v}{r}\frac{dy_p}{dt}\right)\vec{i} + \left(\frac{v}{r}\frac{dx_p}{dt}\right)\vec{j}$$

$$\vec{a} = \left(-\frac{v^2}{r}\cos\theta\right)\vec{i} + \left(-\frac{v^2}{r}\sin\theta\right)\vec{j}$$

$$a = \sqrt{a_x^2 + a_y^2} = \frac{v^2}{r}\sqrt{(\cos\theta)^2 + (\sin\theta)^2} = \frac{v^2}{r},$$

$$a = \frac{v^2}{r}$$ Centripetalno ubrzanje

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