$$\vec{L} = \vec{r} \times \vec{p} = \vec{r} \times m\vec{v} = m(\vec{r} \times \vec{v})$$

$$\dot{\vec{L}} = m\left(\dot{\vec{r}} \times \vec{v} + \vec{r} \times \dot{\vec{v}}\right)$$

$$= \underbrace{m(\dot{\vec{r}} \times \vec{v})}_{= \vec{0}} + m(\vec{r} \times \dot{\vec{v}})$$

$\vec{r} \parallel \vec{v}$

$$\Rightarrow \quad \dot{\vec{L}} = m\,\vec{r} \times \underbrace{\dot{\vec{v}}}_{\vec{a}} =$$

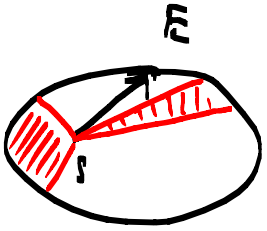
$$\Rightarrow \quad \dot{\vec{L}} = m\, r \times \vec{a} = \vec{r} \times \underbrace{m\vec{a}}_{\vec{F}}$$

$$\Rightarrow \quad \dot{\vec{L}} = \vec{r} \times \vec{F}$$

$\vec{a} \times \vec{b}$

$= 2(\vec{a} \times \vec{b})$

$$|\vec{a} \times \vec{b}| = |\vec{a}| \cdot |\vec{b}| \cdot \sin \sphericalangle(\vec{a}, \vec{b})$$



bei Zentralkräften: $\vec{r} \parallel \vec{v} \Rightarrow \dot{\vec{L}} = \vec{0}$

$$\Rightarrow \vec{L} = \text{const.}$$

$y = y(x) \qquad x = x(t) \qquad y = y(t)$

$$\frac{d}{dt} y(x(t)) = \frac{dy}{dx} \cdot \frac{dx}{dt}$$

$$\frac{d}{dx}\, y(t(x)) \qquad \frac{dy}{dt}\cdot\frac{dt}{dx} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}} = \frac{\dot{y}}{\dot{x}}$$

Ergänzung

$\vec{r}(s)$ auf Bogenlänge parametrisiert

$$s = \int_{t_1}^{t} |\dot{\vec{r}}(t)|\, dt$$

$$\tilde{\vec{r}}(s) = \vec{r}(t(s)) \qquad t = t(s)\,;\; s = s(t)$$

$$\tilde{\vec{r}}'(s) = \frac{d\vec{r}}{dt}\cdot\frac{dt}{ds} = \frac{\frac{d\vec{r}}{dt}}{\frac{ds}{dt}} = \frac{\dot{\vec{r}}}{|\dot{\vec{r}}|} \Rightarrow \left|\tilde{\vec{r}}'(s)\right| = 1$$

$\left(\tilde{\vec{r}}'(s) = \frac{d\vec{r}}{ds}\right)$

$y = 4x^2 \,, \quad x \geq 0$

$x = t$

$y = 4t^2$

$$\vec{r}(t) = \begin{pmatrix} t \\ 4t^2 \end{pmatrix} \qquad t \geq 0$$

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oder: $x = 2t$

$y = 4(2t)^2 = 16t^2$

$$\vec{r}(t) = \begin{pmatrix} 2t \\ 16t \end{pmatrix}$$

Kreis: $x^2 + y^2 = 1$

$$\vec{r}(t) = \begin{pmatrix} \cos t \\ \sin t \end{pmatrix} \qquad t \in [0, 2\pi)$$

$$\vec{r}(t) = \begin{pmatrix} \cos(2t) \\ \sin(2t) \end{pmatrix} \qquad t \in [0, \pi)$$

$$x^2 + y^2 + z^2 = 1 \qquad \begin{aligned} x &= \cos t \\ y &= \sin t \end{aligned}$$

$$z = \pm\sqrt{1 - (x^2 + y^2)}$$

$$z(t) = 1 -$$

$$z = x^2 + y^2 = f(x, y)$$

$$\vec{r}(u, v) = \begin{pmatrix} u \\ v \\ u^2 + v^2 \end{pmatrix} \qquad \begin{aligned} u &= \sin t \\ v &= \cos t \end{aligned}$$

$$\vec{r}(t) = \begin{pmatrix} \sin t \\ \cos t \\ 1 \end{pmatrix}$$