

1 page summary of physics engine

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position

$$s = vt$$

velocity

$$v = at$$

acceleration

$$a$$

force

$$\vec{F} = ma$$

momentum

$$p = mv$$

impulse

$$I = Ft$$

$$\begin{aligned} \Delta I &= F \Delta t \\ &= ma \Delta t \\ &= m \Delta v \\ &= \Delta p \end{aligned}$$

rotation

$$\theta = \omega t$$

angular velocity

$$\vec{\omega} = \vec{v}_\perp / r$$

$$= (\vec{r} \times \vec{v}) / r^2 \quad (\text{see Fig. 1})$$

angular acceleration

$$\vec{\alpha} = (\vec{r} \times \vec{a}) / r^2$$

torque

inertia

$$\tau = r \times F = I \alpha$$

angular momentum

$$L = r \times p = I \omega$$

Fig. 1

$$\begin{vmatrix} i & j & k \\ a & b & 0 \\ r & 0 & 0 \\ i & j & k \\ a & b & p \end{vmatrix}$$



$$\begin{matrix} \vec{v}_T \uparrow \\ \hline r \end{matrix} \quad \vec{v} \quad (a, b)$$

$$r b k$$

$$\begin{aligned} &\rightarrow r \vec{v}_T k \Rightarrow \frac{r v_T k}{r} \\ &= \vec{v}_T k \end{aligned}$$



$$s = vt$$

$$\theta = \omega t$$

(2)

$$V = at$$

$$\vec{w} = \vec{v}_\perp / r \quad (\text{fig 1})$$

$$= (\vec{r} \times \vec{v}) / r^2$$

a

$$\vec{a} = (\vec{r} \times \vec{\omega}) / r^2$$

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

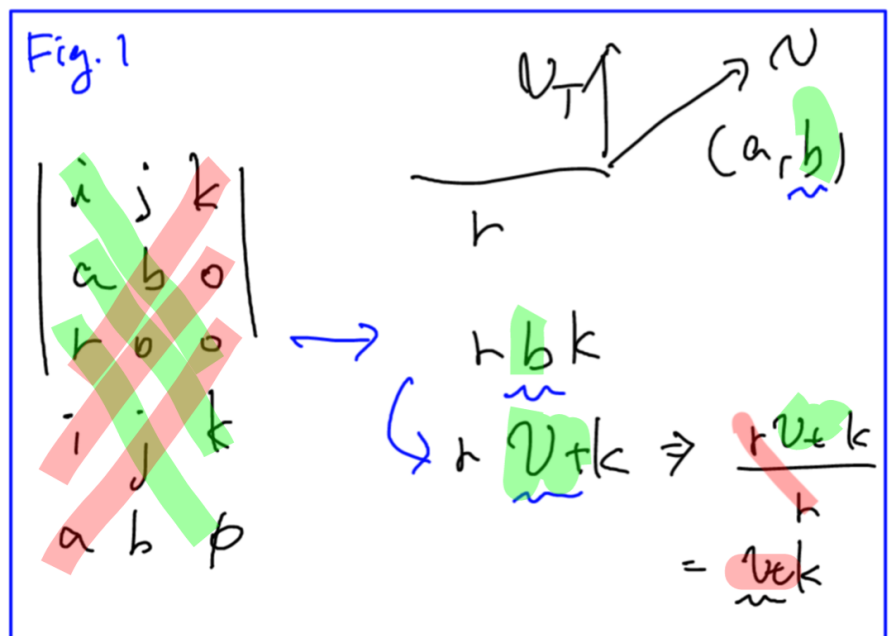
$$\tau = r \times F = \underline{I} \alpha$$

$$p = mv$$

$$L = r \times p = I \omega$$

$$I = F t$$

$$\begin{aligned}\Delta I &= F \Delta t \\ &= m \Delta v \\ &= \Delta p\end{aligned}$$



$$s = vt$$

$$\theta = \omega t$$

$$v = at$$

$$\vec{\omega} = \vec{v}_{\perp} / r$$

$$= (\vec{r} \times \vec{v}) / r^2 \quad [\text{Fig. 1}]$$

a

$$\vec{a} = (\vec{r} \times \vec{\omega}) / r^2$$

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

$$\tau = r \times F = I\alpha$$

$$p = mv$$

$$L = r \times p = I\omega$$

$$I = \vec{F} t$$

$$\begin{aligned} \Delta I &= F \Delta t \\ &= m a \Delta t \\ &= m \Delta v \\ &= \Delta p \end{aligned}$$

Fig. 1

$$\begin{vmatrix} i & j & k \\ a & b & 0 \\ r & 0 & 0 \\ i & j & k \\ a & b & p \end{vmatrix}$$



$$\begin{aligned} & \vec{v}_T \uparrow \quad \vec{v} \nearrow (a, b) \\ & \quad \quad \quad r \\ & \quad \quad \quad r b k \\ & \quad \quad \quad r v_T k \Rightarrow \frac{r v_T k}{r} \\ & \quad \quad \quad = v_T k \end{aligned}$$

① $S = vt$
differentiation
④ $V = at$
integration

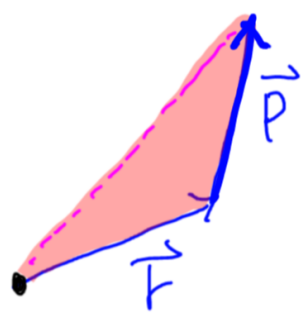
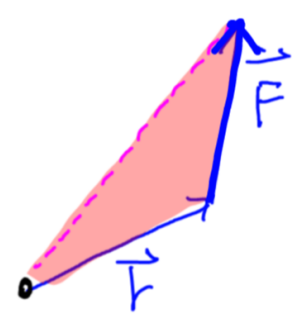
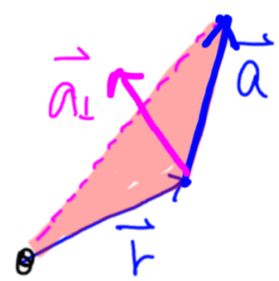
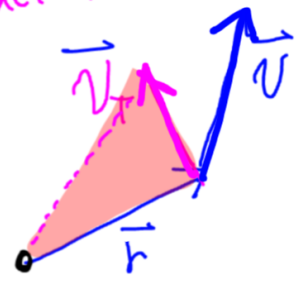
② a
differentiation
③ integration

③ $\vec{F} = ma$
②

$$p = mv$$

$$I = \vec{F}t$$

$$\begin{aligned}\Delta I &= F \Delta t \\ &= ma \Delta t \\ &= m \Delta v \\ &= \Delta p\end{aligned}$$



$$\theta = \omega t$$

$$\omega = \frac{v_{\perp}}{r} = \frac{(\vec{r} \times \vec{v})}{r^2} \text{ [Fig. 1]}$$

$$\vec{a} = \frac{(\vec{r} \times \vec{a})}{r^2}$$

$$\tau = r \times F = I \alpha$$

$$L = r \times p = I \omega$$

Fig. 1

$$\begin{vmatrix} i & j & k \\ a & b & 0 \\ r & 0 & 0 \\ i & j & k \\ a & b & p \end{vmatrix}$$

$$\begin{aligned}&\frac{v_T}{r} \rightarrow \frac{v}{(a, b)} \\&\rightarrow \frac{r b k}{r v + k} \Rightarrow \frac{r v + k}{r} \\&= \underline{v} k\end{aligned}$$

① differentiation
 $S = vt$
 $V = at$

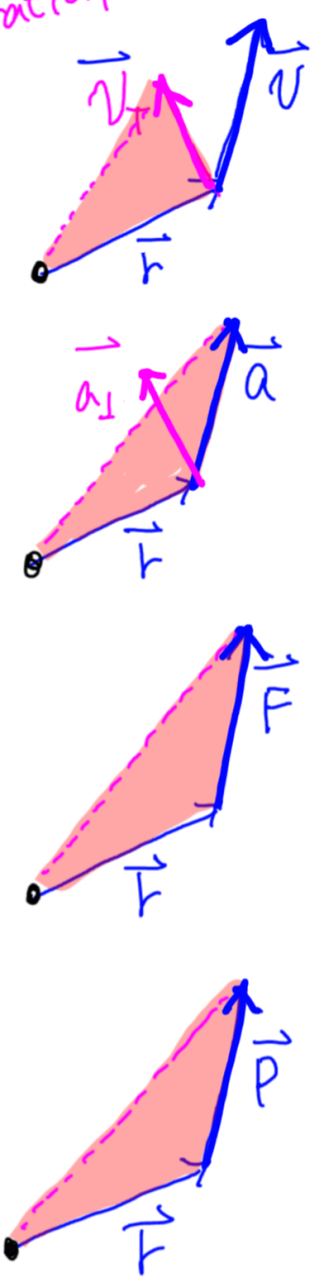
② differentiation
 a

③ differentiation
 $\vec{F} = ma$

$p = mv$

$I = \vec{F}t$

$\Delta I = F \Delta t$
 $= ma \Delta t$
 $= m \Delta v$
 $= \Delta p$



⑤
 $\theta = \omega t$
 $\vec{\omega} = \vec{v}_\perp / r = \vec{r} \times \vec{v}_\perp / r^2$
 $= (\vec{r} \times \vec{v}) / r^2$ [Fig. 1]

$\vec{\alpha} = (\vec{r} \times \vec{a}) / r^2$

$\tau = \vec{r} \times \vec{F} = I \alpha$

③
 $\omega = L / I$

②
 $L = \vec{r} \times \vec{p} = I \omega$

Fig. 1

$$\begin{vmatrix} i & j & k \\ a & b & 0 \\ r & 0 & 0 \end{vmatrix} \rightarrow \begin{vmatrix} i & j & k \\ r & 0 & 0 \\ a & b & p \end{vmatrix}$$

$$\rightarrow r \begin{vmatrix} i & j & k \\ 0 & 0 & 1 \\ a & b & p \end{vmatrix} \Rightarrow \frac{r v_\perp k}{r} = v_\perp k$$

$$\frac{v_T}{r} \rightarrow \frac{v}{(a, b)}$$