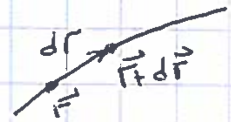
L13

Kinetik energy.

$T = \frac{1}{2} m V^2$ (non-relativistic NM)

$\frac{dT}{dt} = \frac{1}{2} m (\dot{\vec{v}} \cdot \vec{v} + \vec{v} \cdot \dot{\vec{v}}) = m \dot{\vec{v}} \vec{v}$



$\frac{dT}{dt} = \vec{F} \cdot \vec{v} \longrightarrow dT = \vec{F} \cdot d\vec{r} = dW$

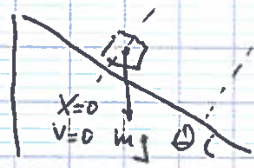
Work-KE theorem: change of kinetic energy between points 1 & 2 on the path is equal to work done by force

$W_{12} = \Delta T_{12} = \sum \vec{F}_i \cdot d\vec{r}_i \to \int_1^2 \vec{F} \cdot d\vec{r} \longrightarrow$

① line integral over particle's path between 1 and 2.

② depends on the scalar product $\vec{F} \cdot d\vec{r}$

Block sliding down the incline (no friction)

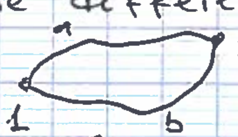


; $v(x_0) = ?$ $\quad T(x_0) = \int_0^{x_0} m\vec{g}\, d\vec{x} =$

$= mg \sin\theta\, x_0 = m \frac{V^2}{2}$; $V = \sqrt{2g \sin\theta\, x_0}$

a) Sum over all forces $\int^2 \sum_i \vec{F}_i\, d\vec{r} = \sum_i \int^2 \vec{F}_i\, d\vec{r}$

b) line integrals for different particle's paths can be different. in general:



$\Delta T_{12}^a \neq \Delta T_{12}^b$

Conservative force

a) depends only on $\vec{r}$: $\vec{F}(\vec{r})$ $\quad \underbrace{\cancel{F(\vec{r}, \vec{v})},\ \cancel{F(\vec{r}, t)}}_{\text{not conservat.}}$

examples: gravitational force: $\vec{F} = \frac{GmM}{r^3} \vec{r}$

electric force: $F = q\vec{E}(r)$

b) Work by conservative force between points 1 & 2 does not depend on selected path. $\Delta T_{12}^a = \Delta T_{12}^b = W_{12}$

Example: friction is not conservative force: $W_{12} = -F_{fr} \cdot L_{12} \to$ different for $L_{12}^a \neq L_{12}^b$