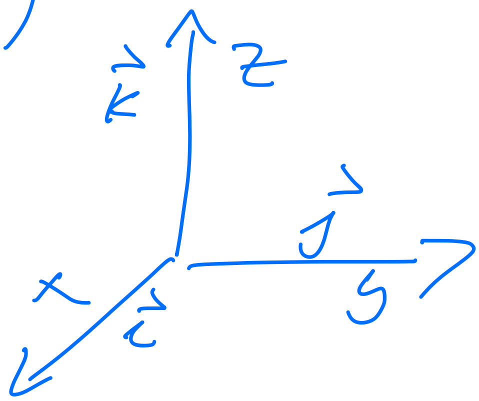
PHYSICS 321 JANUARY 28

4)



cartesian system

$\vec{i} \cdot \vec{j} = \vec{i} \cdot \vec{k} = \vec{j} \cdot \vec{k} = 0$

$|\vec{i}| = |\vec{j}| = |\vec{k}| = 1$

initial velocity

$$\vec{v}(t=0) = \vec{v}_0 = v_0 \cos\theta \, \vec{i} + 0 \vec{j} + v_0 \sin\theta \, \vec{k}$$

$$= (v_0 \cos\theta, 0, v_0 \sin\theta)$$

$$v_z(t) = v_0 \sin\theta - g \cdot t$$

$t_0 = 0$ s

$$x(t) = x_0 + \int_0^t v_x(t) \, dt$$

$$x(t) = x_0 + v_0 \cos\theta \cdot t$$

$y(t) = y_0 = 0$

$z(t) = v_0 \sin\theta \cdot t - gt^2/2$

when does hit the ground?

$z(t_f) = 0 = v_0 \sin\theta\, t_f - g t_f^2/2 \Rightarrow$

$$t_f = \frac{2 v_0 \sin\theta}{g}$$

$$x(t_f) = v_0 \cos\theta \cdot t_f$$

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

$$= v_0^2 \frac{\sin 2\theta}{g}$$

Work-energy theorem

$\vec{F} = \vec{F}(\vec{r}, \vec{v}, t)$

K = kinetic energy

$K = \frac{1}{2} m v^2$

$$\frac{dK}{dt} = \frac{1}{2} m \frac{d(\vec{v}\cdot\vec{v})}{dt}$$

(hw 1 ex 3)

$$= \frac{1}{2} m \left(\frac{d\vec{v}}{dt} \vec{v} + \vec{v} \frac{d\vec{v}}{dt} \right)$$

$$= m \frac{d\vec{v}}{dt} \cdot \vec{v}$$

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

Discretize

$dK \Rightarrow \Delta K$

$dt \Rightarrow \Delta t$

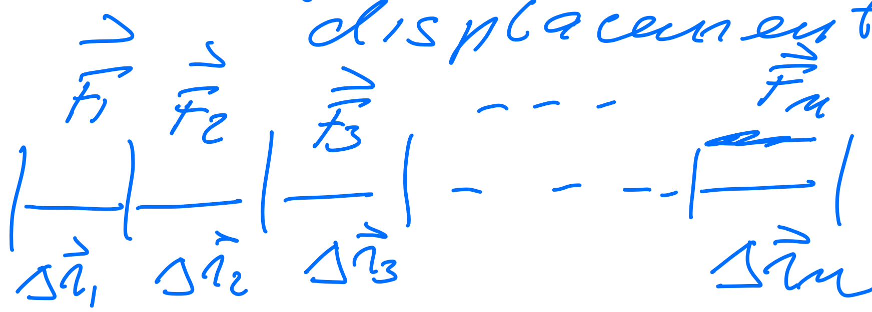
$d\vec{r} = \Delta \vec{r}$

$$\lim_{\Delta t \to 0} \frac{\Delta K}{\Delta t} = \frac{dK}{dt}$$

$$\frac{\Delta K}{\cancel{\Delta t}} = \vec{F} \cdot \frac{\Delta \vec{r}}{\cancel{\Delta t}}$$

$$\Delta K = \vec{F} \cdot \Delta \vec{r}$$

Def: Work done by the force during a displacement $\Delta\vec{r}$



$$\Delta K = \sum \vec{F}_i \cdot \Delta\vec{r}_i$$

$$= \frac{1}{2} m v_n^2 - \frac{1}{2} m v_1^2$$

W = Work done

work-energy $\quad \Delta r \Rightarrow dr$

$$\boxed{W(1 \to n) = \int_C \vec{F}(\vec{r}, \vec{v}, t) \cdot d\vec{r}}$$