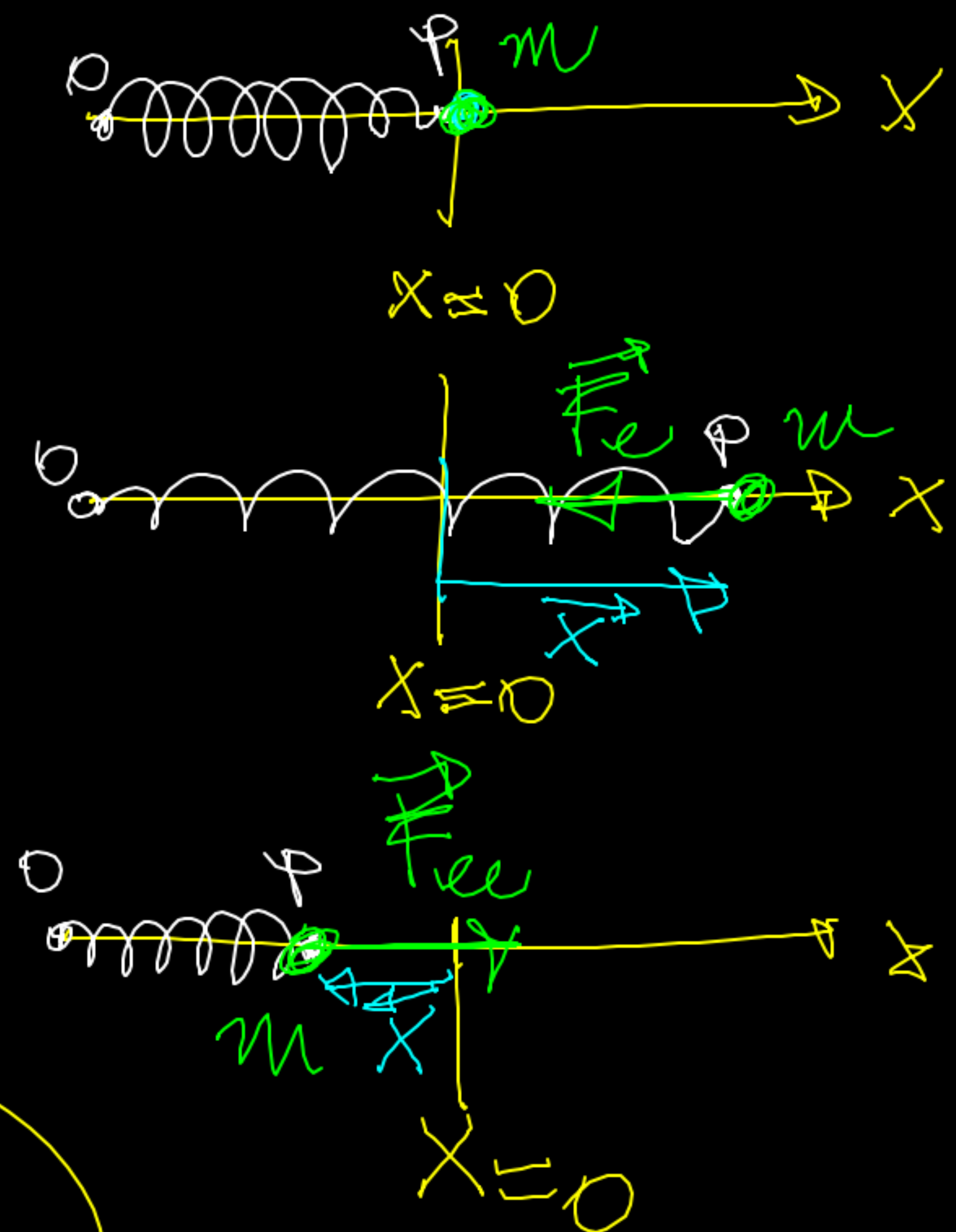
FORZA NON COSTANTE

ES. MOLLA

$$\boxed{\vec{F}_{el} = -k\vec{x}}$$

FORZA EL.



RIPOSO

$\vec{F}_{el} = 0$

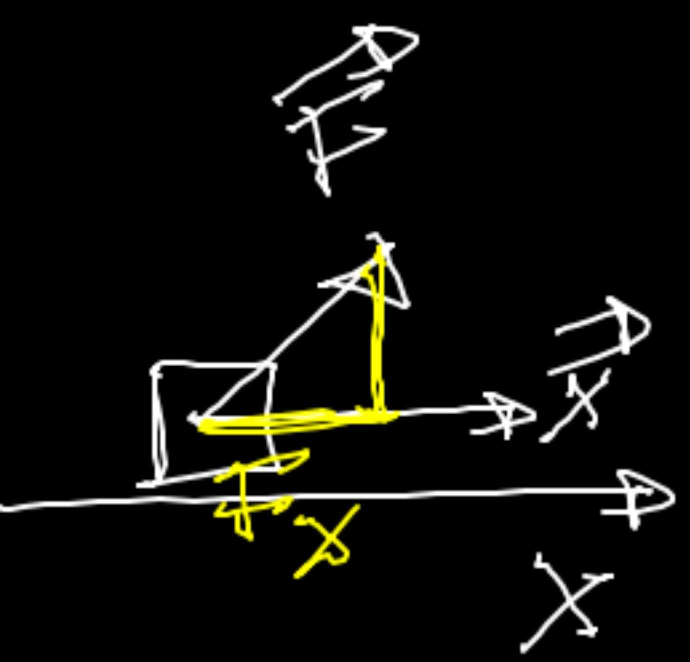
ALLUNG.

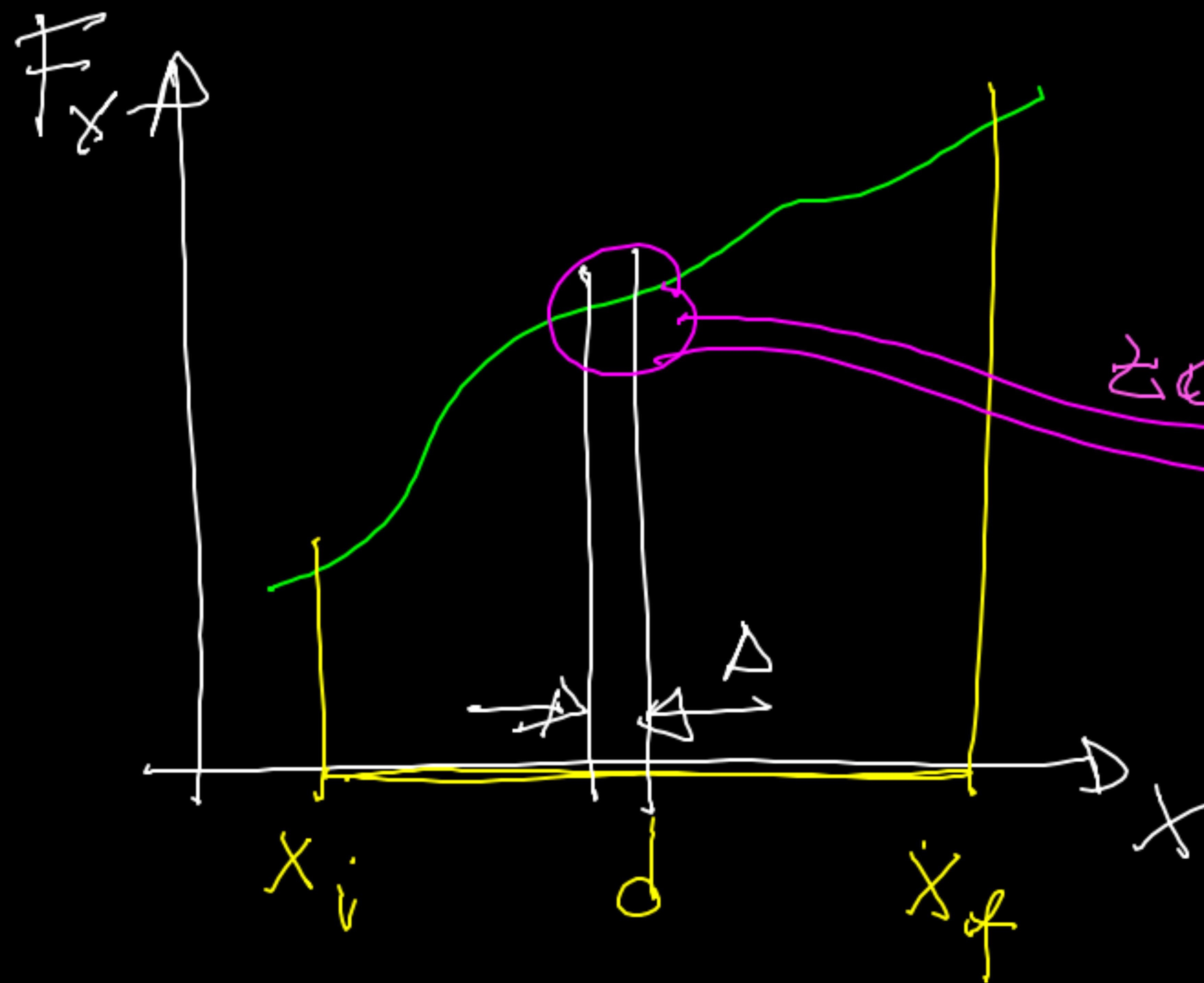
COMPRESS.

ALTRO ES.

↳ GRAVITÀ

FORZA NON COSTANTE



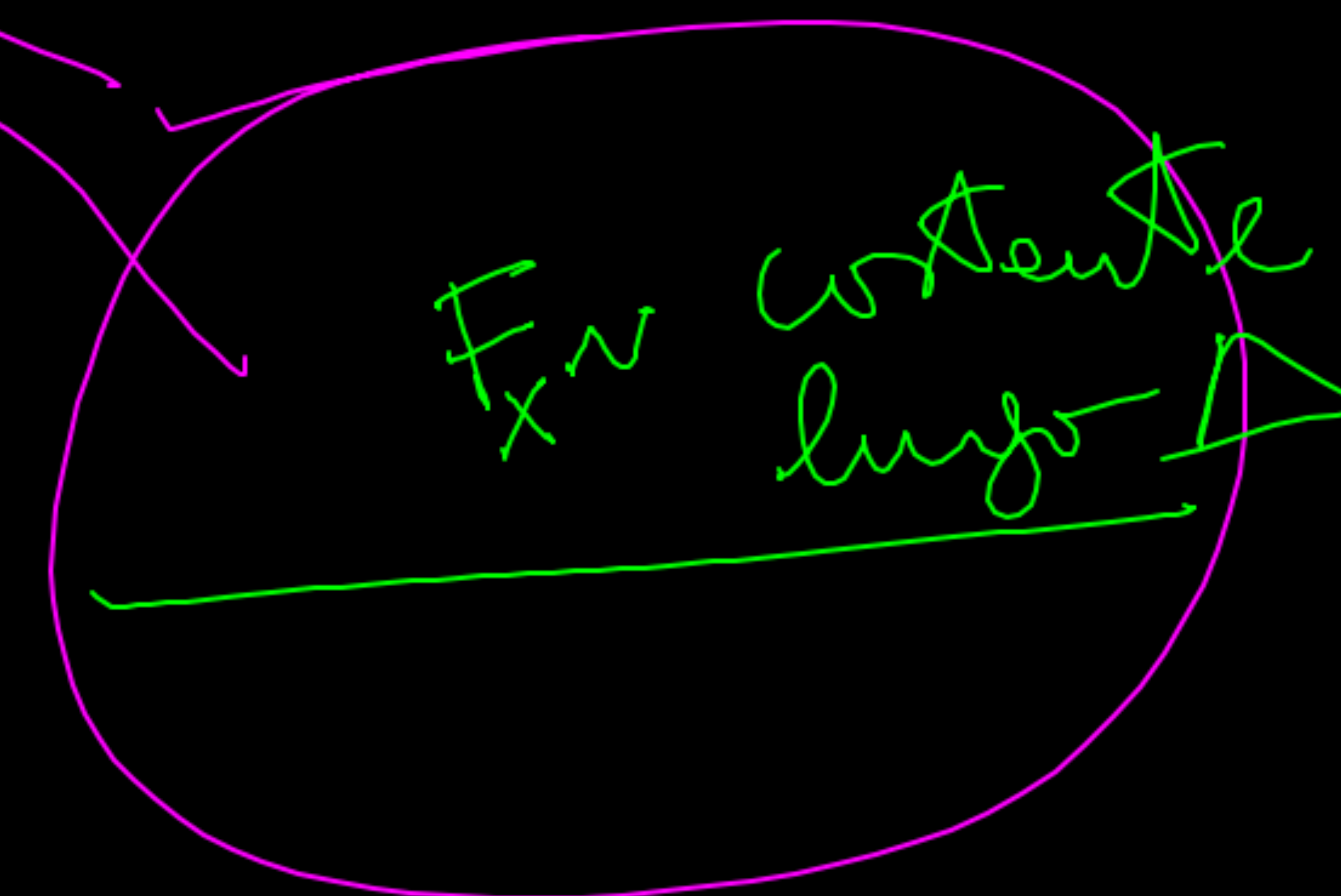


$x_f - x_i = d$

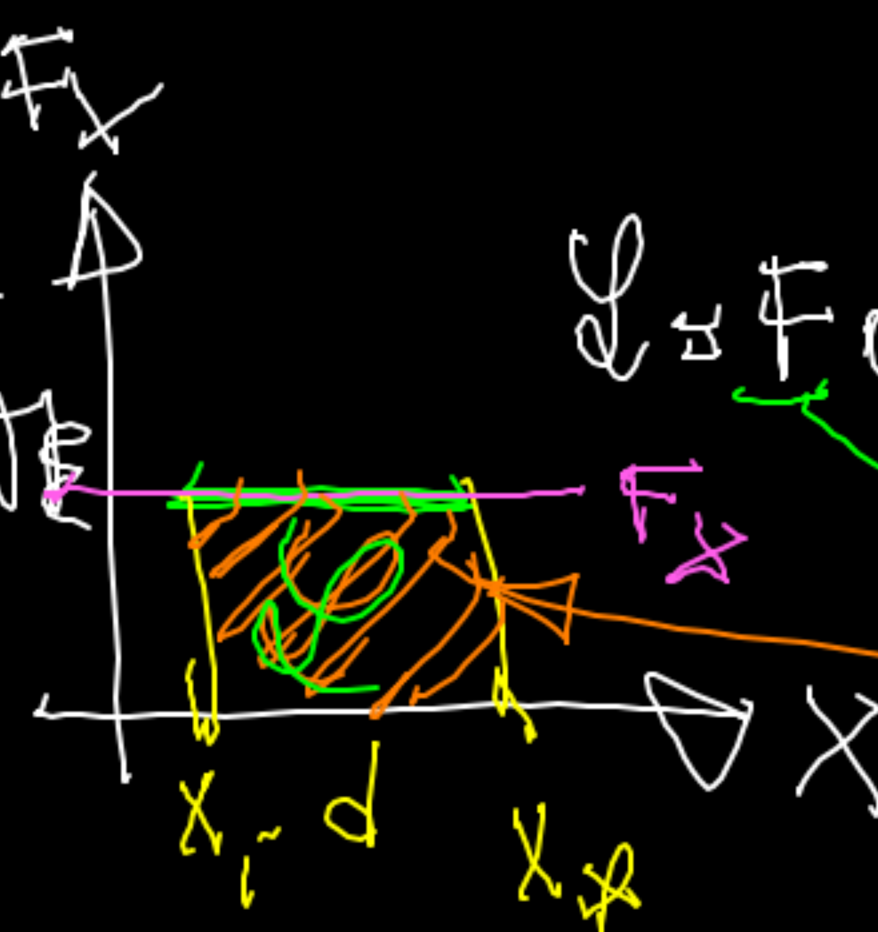
ZOOM

$\sum \Delta = d$

$\Delta \ll d$



FORZA COSTANTE

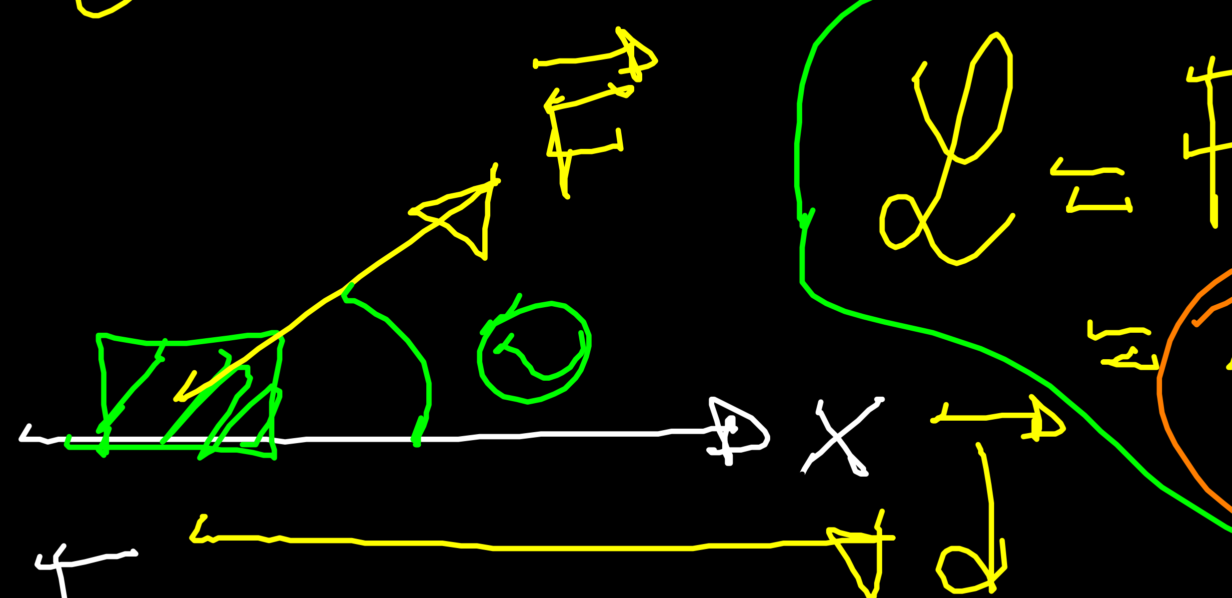


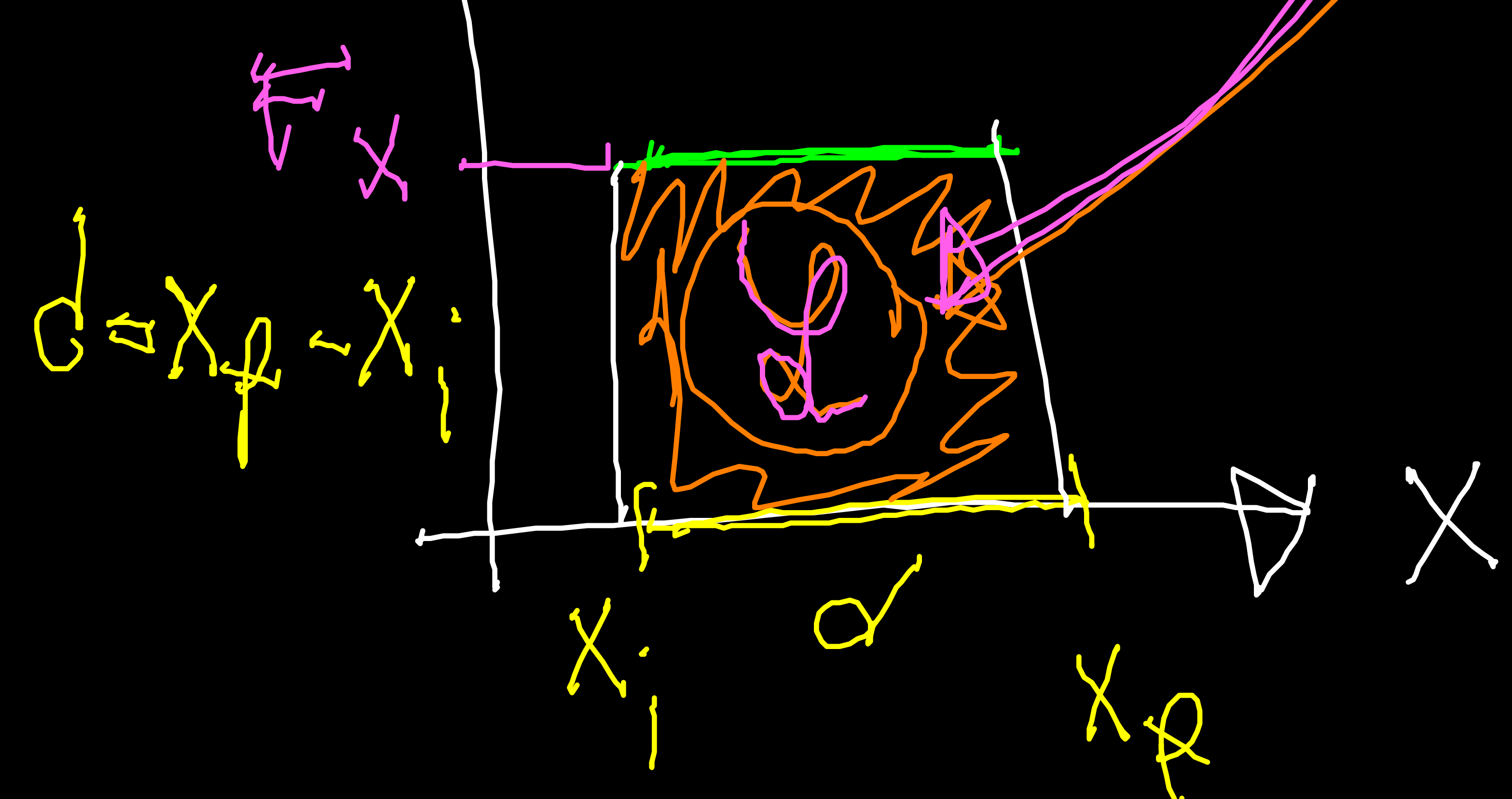
$\mathcal{L} = F d \cos\theta = F_x d$

LAVORO PER $\vec{F}$ COSTANTE

$$\mathcal{L} = W = \vec{F} \cdot \vec{d}$$

$$\mathcal{L} = F d \cos\theta = F_x d$$





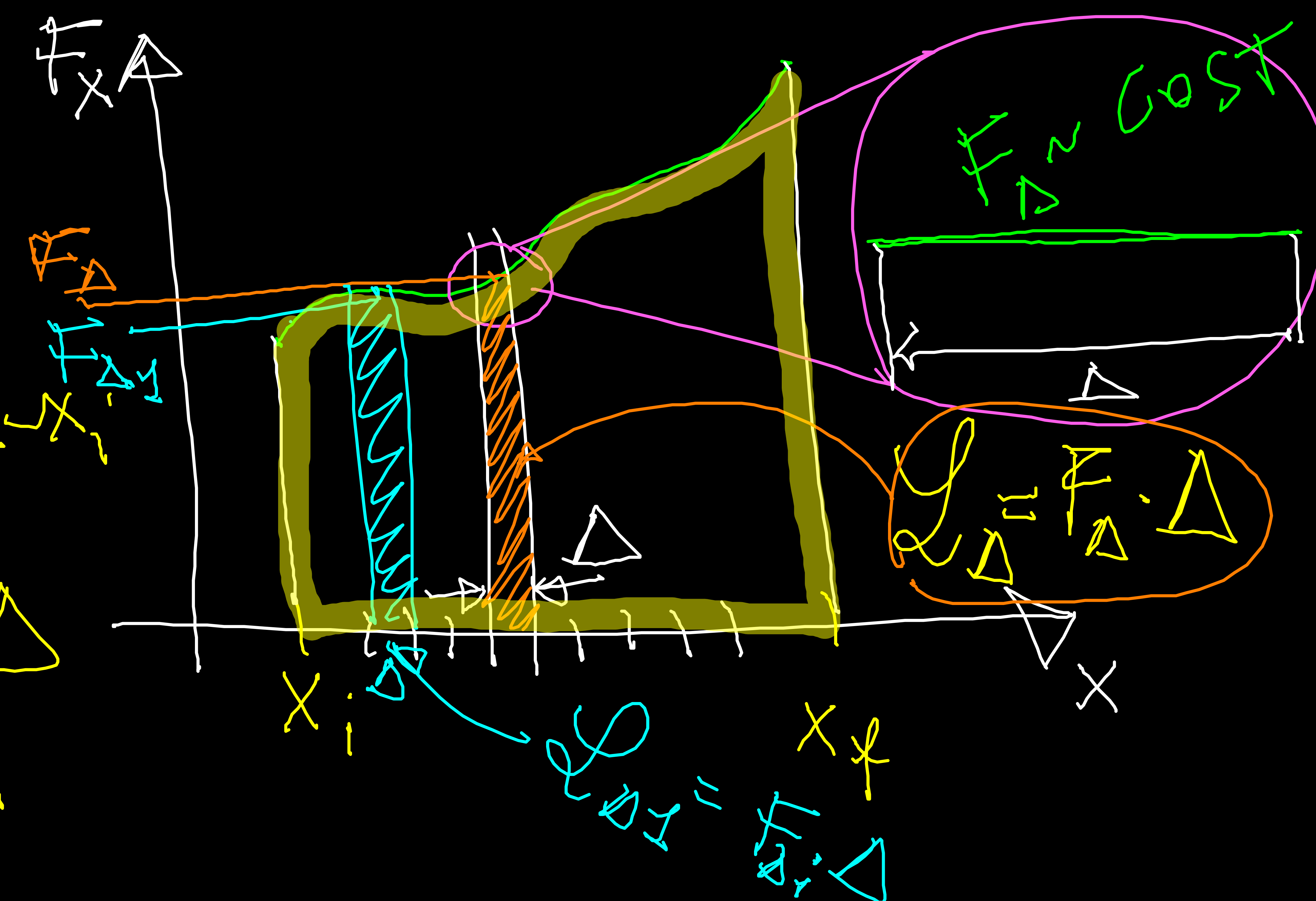
LAVORO PER $\vec{F}$ NON COSTANTE

$$\mathcal{L} = ? \quad \cancel{F_x d} \; ?$$

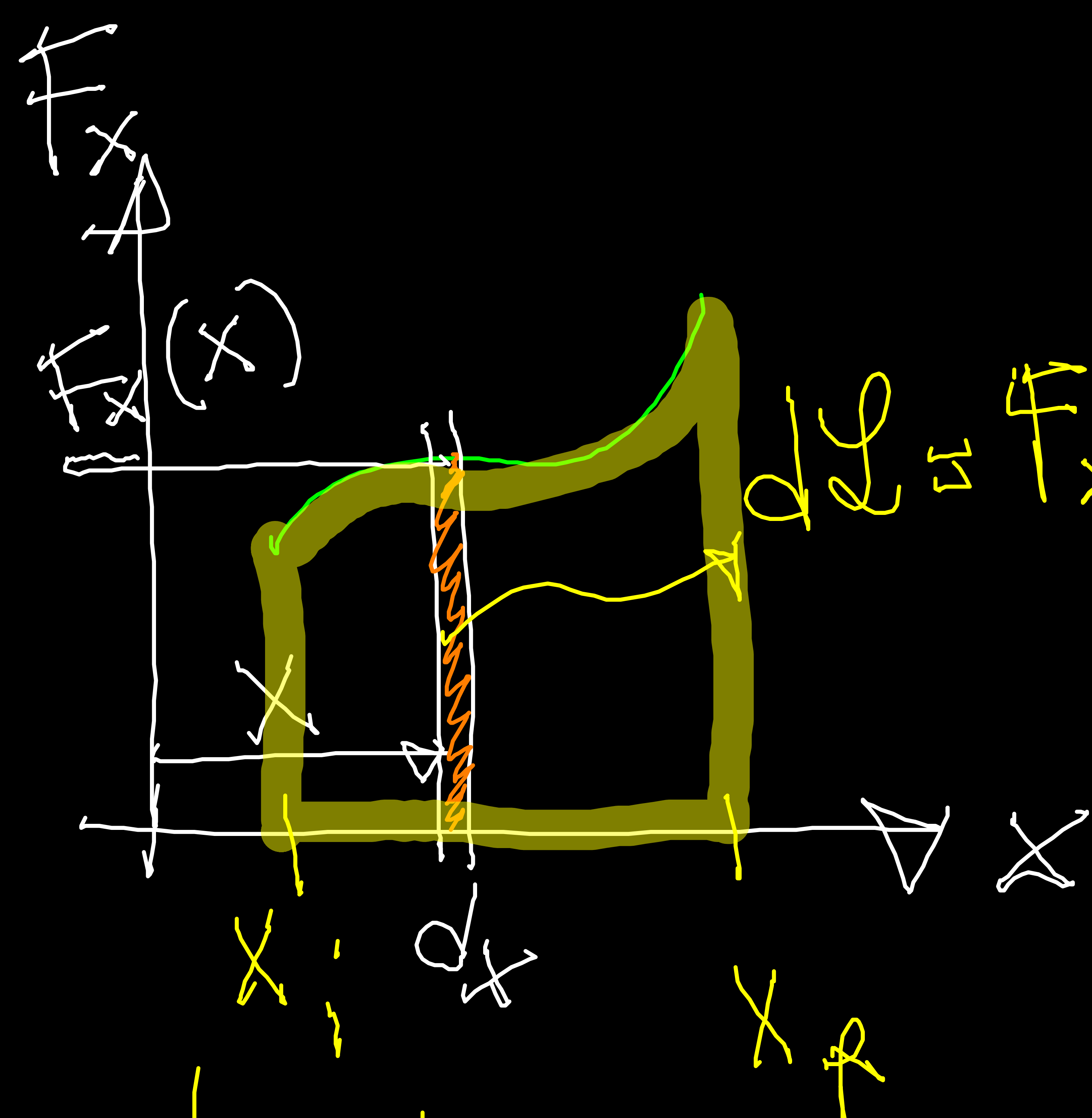
$$d = x_f - x_i$$

$$d = \sum \Delta$$

$$\Delta \ll d$$



$$\mathcal{L}_F = \lim_{\substack{\Delta \to 0 \\ i \to \infty}} \sum_i \underbrace{F_i \, \Delta}_{\mathcal{L}_i} \Longrightarrow \mathcal{L}_F = \int_{x_i}^{x_f} F_x(x)\, dx$$



$$d\mathcal{L} = F_x(x)\, dx$$

$$d = x_f - x_i$$

Se F_x è costante

$$\mathcal{L}_F = \int_{x_i}^{x_f} F_x\, dx = F_x \int_{x_i}^{x_f} dx = F_x (x_f - x_i) = F_x\, d$$

ESEMPIO CON $\vec{F}$ NON COSTANTE
(CASO UNIDIM.)

→ FORZA ELASTICA

$x_i = 0$ $\quad$ $x_f = d$

$$F_x = -Kx$$

K → costante elastica $[N/m]$

$$\mathcal{L}_F = \int_{x_i}^{x_f} F_x(x)\,dx$$

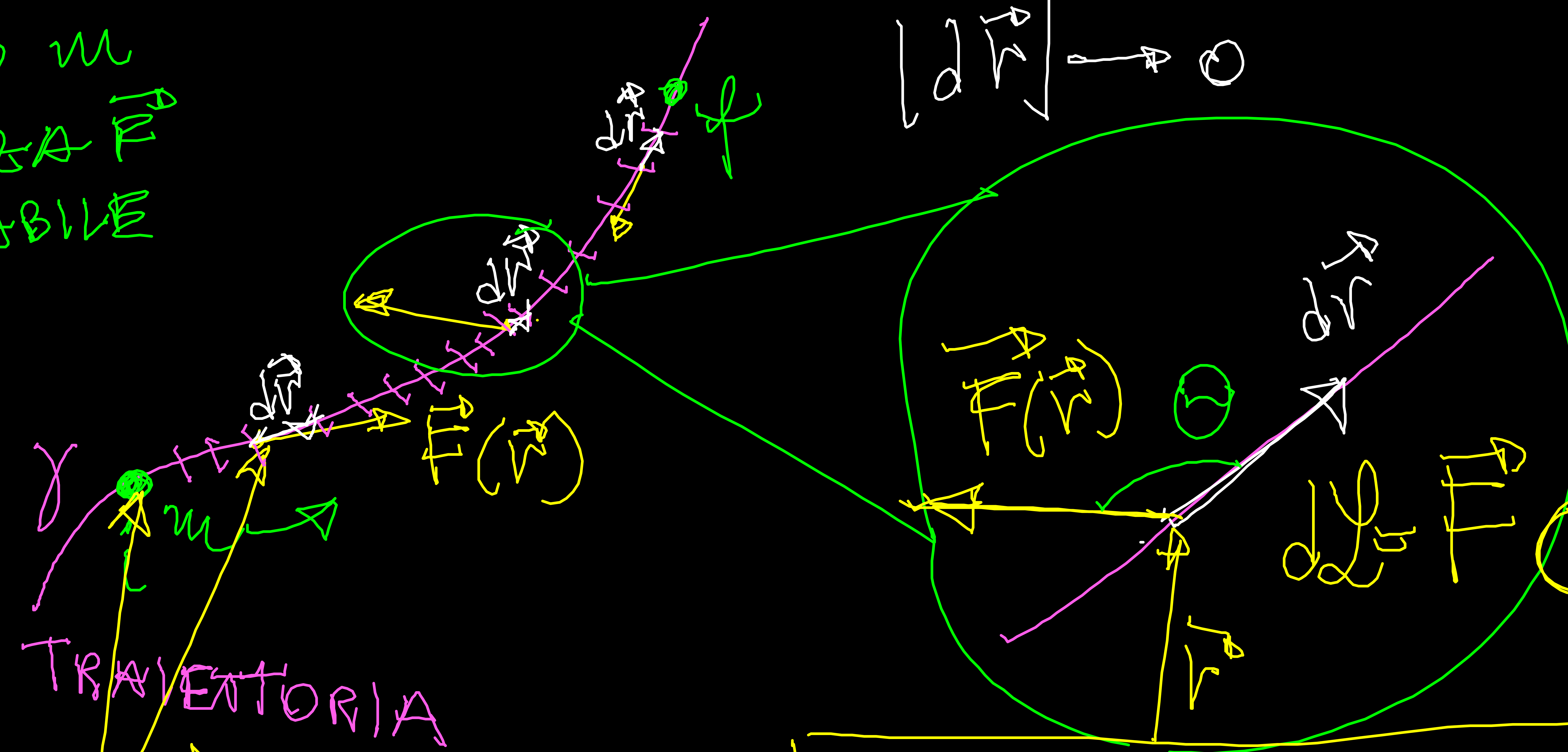
$$\mathcal{L}_{F_{el}}^{AND} = \int_{x_i}^{x_f=d} -Kx\,dx = -K\int_{x_i=0}^{d} x\,dx = -K\left[\frac{x^2}{2}\right] =$$

$$\mathcal{L}_{AND} = -\frac{Kd^2}{2} \qquad x=0 \rightarrow x=d$$

$$x=d \rightarrow x=0 \Rightarrow \mathcal{L}_{RIT} = \frac{Kd^2}{2}$$

DEFINIZIONE GENERALE DI LAVORO

- CORPO m
- FORZA $\vec{F}$ VARIABILE



$$|d\vec{r}| \to 0$$

$$d\mathcal{L} = \vec{F}(\vec{r}) \cdot d\vec{r}$$

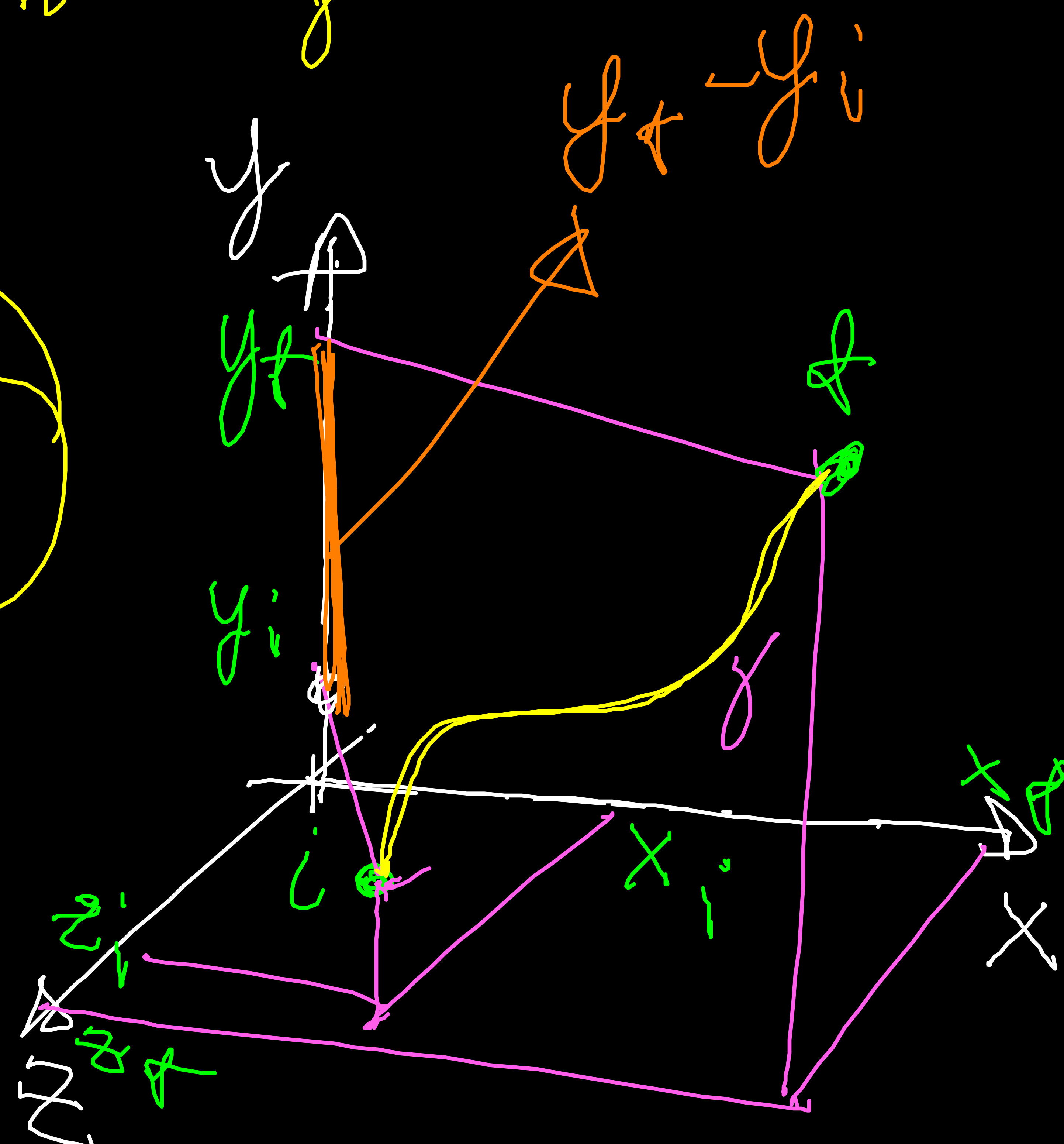
$$\mathcal{L}_F \; (?)$$
$$i \to f, \gamma$$

$$\boxed{\mathcal{L}_{i \to f, \gamma} = \int_\gamma d\mathcal{L} = \int_\gamma \vec{F}(\vec{r}) \cdot d\vec{r}}$$

LAVORO DI $\vec{F}$

$$\mathcal{L}_{i\to f,\gamma} = \int_\gamma \vec F(\vec r)\cdot d\vec r$$

$\vec g \downarrow$



$\hat\jmath \equiv \hat y$

$\hat x \equiv \hat\imath \qquad \hat k \equiv \hat z$

$\hat\imath\cdot\hat\imath = 1$

$\hat\imath\cdot\hat\jmath = 0$

$$\vec F(\vec r) = F_x\hat\imath + F_y\hat\jmath + F_z\hat k$$

$$d\vec r = dx\,\hat\imath + dy\,\hat\jmath + dz\,\hat k$$

$$\vec F(\vec r)\cdot d\vec r = F_x dx\,\cancel{\hat\imath} + F_y dy\,\cancel{\hat\jmath} + F_z dz\,\cancel{\hat k}$$

$F_x(\vec r)$

$$\vec F(\vec r) = m\vec g = (0, -mg, 0)$$

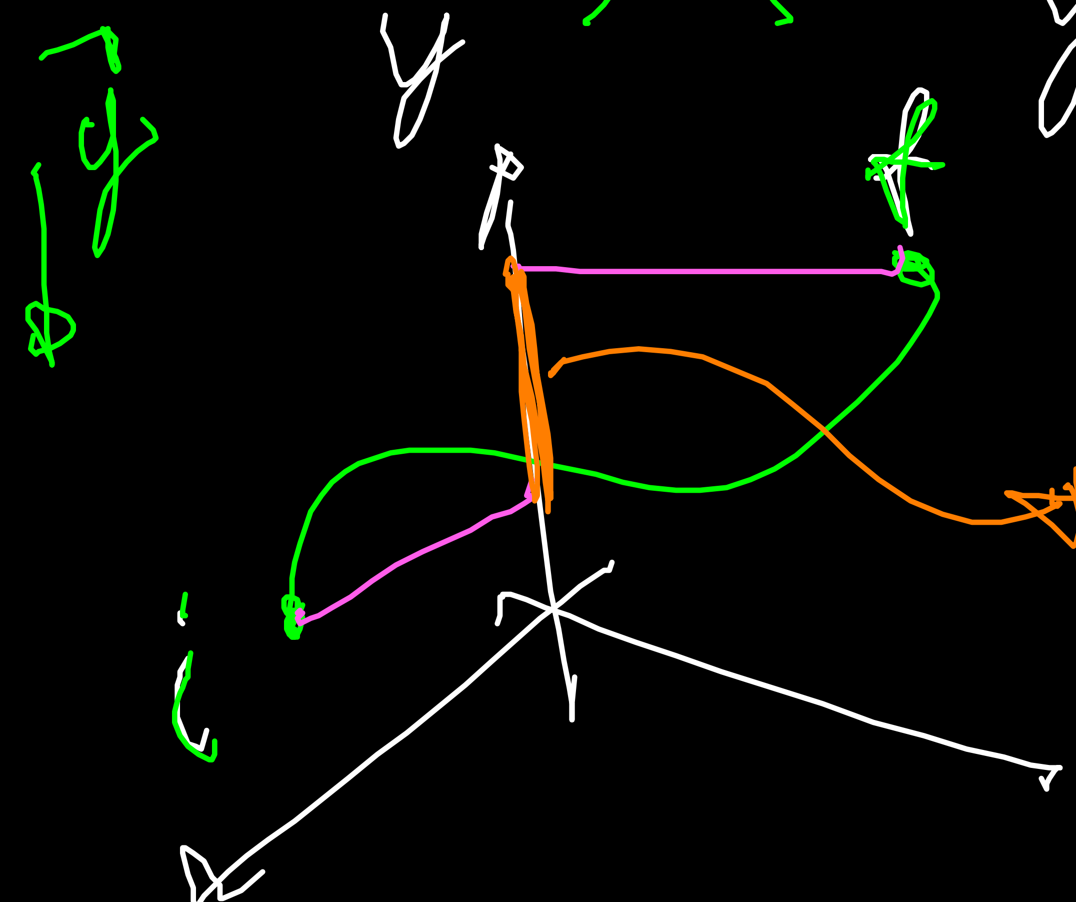
FORZA PESO $\quad F_x \quad F_y \quad F_z$

PER LA FORZA PESO

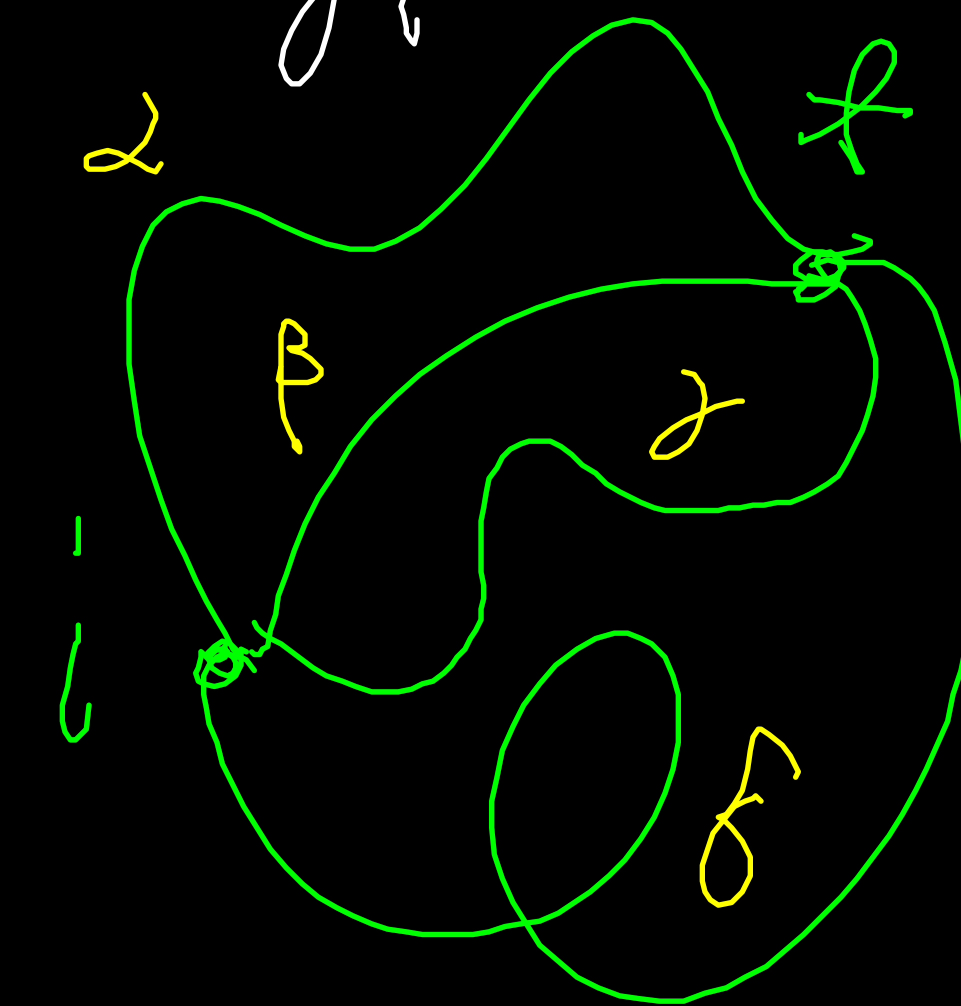
$$\vec F(\vec r)\cdot d\vec r = -mg\,dy$$

$$\mathcal{L}_{i\to f,\gamma} = \int_{x_i}^{x_f}\int_{y_i}^{y_f}\int_{z_i}^{z_f} F_x(\vec{r})\,dx + F_y(\vec{r})\,dy + F_z(\vec{r})\,dz$$

$$\mathcal{L}_{i\to f,\cancel{\gamma}} = \int_{y_i}^{y_f} -mg\,dy = -mg\int_{y_i}^{y_f} dy = -mg\,\overbrace{\underbrace{(y_f - y_i)}_{\text{DIFFERENZA DI QUOTA}}}^{h}$$



$y_f - y_i = h$



γ

$\mathcal{L}$ PESO

È LO STESSO

ENERGIA CINETICA $\longrightarrow$ ASSOCIATA AL MOVIMENTO